Free Route Safety and Performance Requirements (SPR) for Step 1

Document information[1]	
Project Title	Separation Task in En Route Trajectory based environment
Project Number	04.07.02
Project Manager	DSNA
Deliverable Name	Free Route Safety and Performance Requirements (SPR) for Step 1
Deliverable ID	D63
Edition	00.01.03
Template Version	03.00.00
Task contributors	
DSNA, ENAV, NORACON, FLY4D, HONEYWELL, AIRBUS	

Abstract

This document describes the Safety and Performance Requirements (SPR) related to the Free Route operational concept for Step 1 with a focus on the SESAR Solutions #32 and #33 brought to a V3 maturity level.
This Free Route SPR for Step 1 consolidates the operational needs for Airspace Users and ATS providers in support the safe and efficient deployment of Direct Routing operations across ACC/FIR borders and in high complexity environments (Solution #32) and Free Routing operations within permanently low to medium complexity environments (Solution #33).

[1] *This document is a consolidated deliverable handled by Project P04.07.02 dealing with "Separation tasks in En-Route trajectory based environment", but has been developed with the contribution of SESAR Partners from other Projects dealing more generally with "En-Route Operations", "Network Operations" and "FOC/WOC Operations".*

Authoring & Approval

Prepared By - *Authors of the document.*		
Name & Company	Position & Title	Date
[redacted] DSNA	[redacted]	30/11/2016
[redacted] DSNA		28/07/2016
[redacted] ENAV		29/07/2016
[redacted] NORACON		08/07/2016
[redacted] FLY4D (Lufthansa Systems)		30/07/2016
[redacted] DSNA		14/10/2016

Reviewed By - *Reviewers internal to the project.*		
Name & Company	Position & Title	Date
[redacted] DSNA	[redacted]	15/04/2016
[redacted] DSNA		08/06/2016
[redacted] DSNA		15/04/2016

Note: Revised draft versions of the document have been circulated for review to the various SESAR projects and stakeholders interested in the Free Route operational concept. Hereafter is the list of projects / representatives who provided comments during the review cycles.

Reviewed By - *Other SESAR projects, Airspace Users, staff association, military, Industrial Support, other organisations.*		
Name & Company	Position & Title	Date
[redacted] DSNA	[redacted]	30/11/2016
[redacted] NORACON		19/10/2016
[redacted] NORACON		19/10/2016
[redacted] NORACON		19/10/2016
[redacted] FLY4D (Lufthansa Systems)		18/10/2016
[redacted] DSNA		24/08/2016
[redacted] ENAV (SICTA)		08/06/2016
[redacted] ENAV (SICTA)		15/04/2016
[redacted] Skyguide		11/07/2016
[redacted] Skyguide		15/04/2016
[redacted] ENAIRE (INECO)		19/10/2016
[redacted] EUROCONTROL		08/07/2016
[redacted] INDRA		31/08/2016
[redacted] SELEX-ES		05/09/2016
[redacted] DFS		06/07/2016
[redacted] NORACON		06/07/2016
[redacted] EUROCONTROL		07/07/2016
[redacted] ONE WORLD		31/08/2016
[redacted] IATA		31/08/2016

Approved for submission to the SJU By - *Representatives of the company involved in the project.*		
Name & Company	Position & Title	Date
[redacted] DSNA	[redacted]	21/10/2016
[redacted] DFS		07/09/2016
[redacted] EUROCONTROL		08/09/2016
[redacted] HONEYWELL		08/09/2016
[redacted] AIRBUS		09/09/2016
[redacted] THALES		08/09/2016
[redacted] NATS		08/09/2016
[redacted] ENAIRE (INECO)		08/09/2016
[redacted] EUROCONTROL		07/09/2016
[redacted] NORACON		09/09/2016
[redacted] AIRBUS		09/09/2016
[redacted] ENAV (SICTA)		09/09/2016
[redacted] Skyguide		09/09/2016
[redacted] EUROCONTROL		08/09/2016

Rejected By - *Representatives of the company involved in the project.*		
Name & Company	Position & Title	Date
NA		

Rational for rejection
None.

Document History

Edition	Date	Status	Author	Justification
00.00.01	12/02/2016	Draft	[redacted]	New Document with draft material in Chapters 1
00.00.02	25/05/2016	Draft		Draft material in Chapter 2 (from OSED); Draft candidate Safety and Performance requirements in Chapter 3 (after 1st Free Route SPR Workshop focused on Solution #33)

Edition	Date	Status	Author	Justification
00.00.03	17/06/2016	Revised Draft	[redacted]	Update of Chapter 2 (scoping of SESAR Solutions); Consolidated candidate Safety and Performance requirements in Chapter 3 (after 2nd Free Route SPR Workshop focused on Solutions #32 and #33)
00.00.04	27/06/2016	Revised Draft		Update of Chapter 1 (scoping of SESAR Solutions); Update of Chapters 2 and 3 (for consistency)
00.00.05	20/07/2016	Revised Draft		Update of Chapter 3 taking into account comments received after 1st review cycle at OFA level; Milestone for traceability of Safety and Performance requirements by Technical Specifications related to Solutions #32 and #33
00.00.06	19/08/2016	Revised Draft		Update of Chapter 1 and 2 taking into account comments received after 1st review cycle at OFA level; Update of requirement status in Chapter 3 and update of Appendix A (including SAR, EIA and OPA summary)
00.00.07	07/09/2016	Revised Draft		Minor changes in all sections following 2nd review cycle at OFA level; Update of Requirement status and links to Functional Blocks in Chapter 3
00.01.00	09/09/2016	Final		First submission to SJU
00.01.01	14/10/2016	Revised Draft		Maturity of Free Route Solutions (and related dataset) added in Executive summary and section 1; Update of Chapter 2 (with focus on environment characteristics in support to Free Route Solutions); Assumptions (about NM operations) moved to Chapter 2; and recommendations moved to new Appendix A.2.
00.01.02	21/10/2016	Final		Second submission to SJU

Edition	Date	Status	Author	Justification
00.01.03	30/11/2016	Final	[redacted]	Minor changes in Executive summary, section 1.2 and section 2 following SJU assessment after Release 5 System Engineering Review #3 (e.g. reference to PCP removed, concept elements out of scope of Solutions #32 and #33 presented in section 2.1, section 2.1.5 deleted and disclaimer at the end of section 2.3 deleted)

Intellectual Property Rights (foreground)

This deliverable consists of SJU foreground.

Table of Contents

List of tables

List of figures

Executive summary

This Safety and Performance Requirements (SPR) document provides the safety and performance requirements for Processes related to the SESAR Solutions for Free Route in Step 1. The SPR also provides their allocation to Functional Blocks (where applicable). It identifies the requirements needed to fulfil each KPA and include, or reference, the sources justifying those requirements.

This SPR supports the operational services and concept elements identified in the Operational Service and Environment Definition (OSED) for Free Route operations in Step 1 with a focus on two SESAR 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 across ACC/FIR borders within permanently low to medium complexity environments.

The SESAR Solution #32 focuses on the operational needs for Airspace Users and ATS Providers to support safe and efficient Direct Routing operations across ACC/FIR borders and in high complexity environments. This Solution is an extension of the baseline concept of published En-Route DCTs (Directs) to enable seamless Direct Routing operations in larger and more complex environments. It partially contributes to the Step 1 Operational Improvement AOM-0500 as defined in the ATM Master Plan Data Set 16.

The SESAR Solution #33 focuses on the operational needs for Airspace Users and ATS Providers to support safe and efficient Free Routing operations across ACC/FIR borders within permanently low to medium complexity environments. This Solution is an initial step towards the whole concept of Free Routing, which will be further progressed within SESAR 2020 to also cover high complexity environments. It partially contributes to the Step 1 Operational Improvement AOM-0501 as defined in the ATM Master Plan Data Set 16.

The safety and performance requirements (and recommendations for best practices) consolidated in this SPR at the end of V3 are expected to support the safe and efficient deployment of the SESAR Solutions #32 and #33.

1 Introduction

1.1 Purpose of the document

This Safety and Performance Requirements (SPR) document provides the safety and performance requirements for Processes related to the SESAR Solutions for Free Route in Step 1. The SPR also provides their allocation to Functional Blocks (where applicable). It identifies the requirements needed to fulfil each Key Performance Area (KPA) to which the Free Route Solutions contribute to and include, or reference, the sources justifying those requirements..

1.2 Scope

This document supports the operational services and concept elements identified in the Operational Service and Environment Definition (OSED) for Free Route operations in Step 1 [33] with a focus on two SESAR Solutions, i.e.:

- **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 across ACC/FIR borders within permanently low to medium complexity environments.

These Free Route SESAR Solutions contribute partially to the Step 1 Operational Improvements AOM-0500 and AOM-0501 respectively, as defined in the ATM master Plan Data Set 16 (which is the reference dataset [18] for this document). They aim to extend the today's Free Route initiatives for seamless and more efficient Direct Routing or Free Routing operations across ACC/FIR borders in environments of different complexity.

The SESAR Solution #32 focuses on the operational needs for Airspace Users and ATS Providers to support safe and efficient Free Route operations through the use of optimised Direct Routings established across ACC/FIR borders and in high complexity environments.

The SESAR Solution #33 focuses on the operational needs for Airspace Users and ATS Providers to support safe and efficient Free Route operations through the ability of Airspace Users to plan/re-plan route according to user-defined segments within significant blocks of Free Routing Airspace of permanently low to medium complexity. Operational procedures and technologies supporting seamless Free Routing operations in high complexity environments will need to be further progressed.

This Free Route Step 1 SPR consolidates the Safety and Performance requirements related to the SESAR Solutions #32 and #33 at the end of the V3 validation phase. It also provides recommendations to improve the safety and performance aspects of the Free Route Solutions where applicable taking into account the local AU or ATS environment characteristics. Finally, it describes the operational environment in which the Solutions are intended to be operated, including assumptions related to the Network Manager operations.

The requirements - and recommendations for best practices – contained in this SPR are expected to support the safe and efficient deployment of the SESAR Solutions #32 and #33.

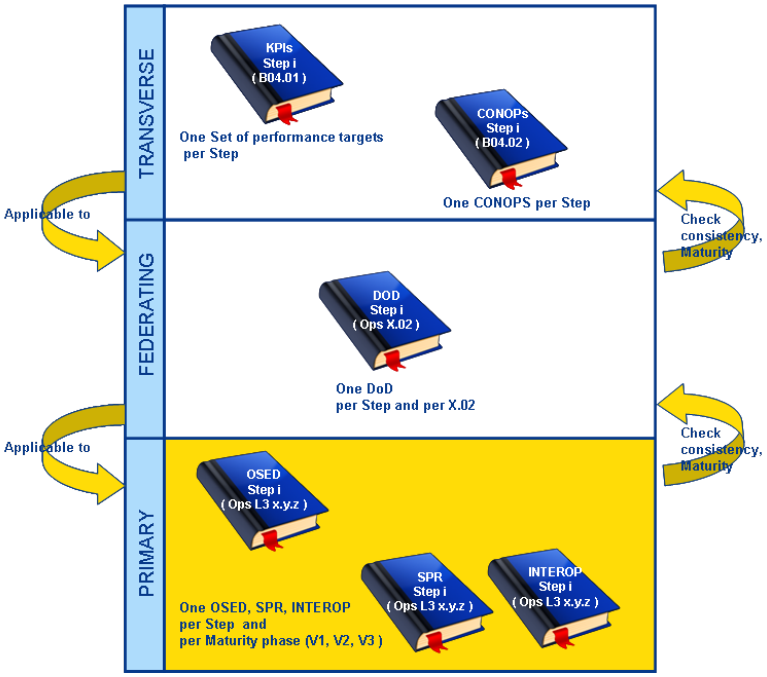

Figure 1: SPR document with regards to other SESAR deliverables

In Figure 1, the Steps are driven by the OI Steps addressed by the project in the Integrated Roadmap document [26].

The Free Route Step 1 OSED (developed at the end of V2 maturity level) has a broader scope than the Solutions #32 and #33 described in this SPR document (that takes into account the outcomes of V3 validation exercises conducted in the frame of SESAR). For sake of clarity, the concept elements not covered by this Free Route Step 1 SPR, and therefore not part of the SESAR Solutions #32 and #33, are listed in section 2.1.5.

1.3 Intended readership

The intended audience of this Free Route SPR document at the end of V3 includes:

- The stakeholders in charge of authorising, accompanying and monitoring the deployment of the Free Route ATM functionality #3.2 of the PCP;
- The stakeholders directly involved in Free Route operations (i.e. Civil / Military Airspace Users, Network Manager, FABs / ANSPs, Air Traffic Controllers and Pilots); and
- The SESAR 2020 partners (as background material to further progress more demanding Free Routing OIs).

1.4 Structure of the document

Chapter 1 describes the document structure and content of this SPR, which template is adapted from EUROCAE SPR documents to meet SESAR needs.

Chapter 2 summarises the Free Route operational concept in Step 1, its concept elements, the related operational processes at Airspace User, Network and ATS level, and the characteristics of the targeted operational environment.

Chapter 3 describe the Safety and Performance requirements, as well as recommendations and assumptions, for Business/Mission Trajectory flight planning and execution, Airspace Management, ATFCM processes and Ground-based separation processes in support to the Free Route SESAR Solutions #32 and #33. The SPR requirements are defined with traceability to the Operational requirements applicable to these processes as described in the OSED and with allocation to Functional Blocks (where applicable).

Chapter 4 identifies the documents the SPR has to comply to or to be used as additional inputs for the SPR.

Appendix A provides the material that justifies the requirements and their allocation, including summary or reference to relevant safety and performance assessments and results of validation gathered in Validation reports.

1.5 Background

The Free Route operational concept has been under development for many years now (before, aside and in the context of the SESAR Programme). The safety and performance requirements developed in this SPR build upon a lot of background information from other initiatives / projects / studies related to Free Route, among which:

- The EUROCONTROL European Route Network implementation plan (ERNIP), and more specifically ERNIP Part 1 that contains European Airspace Design Methodology Guidelines providing general principles and technical specifications for airspace design including for Free Route Airspace Design in current and future environment (see section 6.5 of [10]).

- The outcomes of the SJU Free Route Task Force 2013-2014. This Task Force was set up in response to a request by the Integrated Roadmap DS11 Change Board to clarify some elements related to Free Route. The objectives were to address clarifications required for the Pilot Common Project (PCP), to set the framework for subsequent SESAR work and to deliver in time for the Data Set 12 campaign. The SJU Free Route Task Force final report (see [26]) provided agreed foundation for individuals and organisations engaged in Free Route descriptive activity such as R&D work, high level policy documentation and local ANSP implementation.

- The SESAR Free Route OSED for Step 1 [33] developed in two iterations in the frame of the Operational Focus Area (OFA) OFA03.01.03 related to Free Route. The first iteration (04.07.02-D36) was developed building on the outcomes of the SJU Free Route Task and the former Free Route Step 1 OSED developed by project 07.05.03, but did not yet contain mature operational requirements. The second iteration (04.07.02-D37) has been produced taking into account the update of P4.2 and P7.2 Step 1 DODs for the European ATM Master Plan Data Set 13, as well as a series of workshops conducted (at OFA level) with various ATM stakeholders, to derive operational requirements for the SESAR Solutions #32 and #33.

- To reflect the Free Route OSED iteration 2 content, and in a collaborative work with P04.02 the Free Route OI Steps have been amended in DS16 which was then the reference Data Set for the subsequent work conducted to progress the maturity of the Free Route SESAR Solutions.

- The validation activities conducted within SESAR to achieve a V3 maturity level of the SESAR Solutions #32 and #33, as well as demonstration activities executed through SESAR Demo projects to confirm this maturity.
    - The following validation activities contribute to the V3 maturity the Solution #32:
        - User Preferred Routing inside Maastricht Airspace (EXE-07.05.03-VP-571): this Real Time Simulation exercise aimed at validating the feasibility of the UPR concept using DCT routes between entry and exit points. It also looked into the use of the UPR concept in a cross border environment and crossing active AMC-manageable airspace.
        - Integrated and pre-operational validations took place in order to focus on ATC tools, and IOP in a Direct Routing environment (EXE-04.03-VP-798).
        - Some Demo projects (FRAMAK, WE-FREE and FREE Solutions) aimed to validate various implementations of published direct segments (e. g. long range, cross border, high density).
    - The following validation activities contribute to the V3 maturity the Solution #33:
        - First validation campaign consisted in a Live trial evaluating free routing for few flights in cruise above FL285 (EXE-07.05.03-VP465).

- A Real Time Simulation exercise involving the FOCs, Network management and ANSPs (EXE-04.03-VP-797) aimed at validating the Free Routing concept in the European core area, including minimum Flight Level and associated acceptable complexity level within the airspace.
- After these specific validations, widest integrated and pre-operational validations took place in order to focus to focus on ATC tools and IOP (EXE-04.03-VP-798).
- Some Demo projects (FRAMaK and FREE Solutions) aimed to validate a set of long range scenarios and cross-border Free Routing operations.

- Two Safety and Performance Requirements workshops organised to progress the development of the Free Route Step 1 SPR building on the above validation exercise results. These workshops were dedicated to the review of candidate requirements to agree on their relevance ("shall" or "should"), phrasing and level of maturity in relation with the scoping of the SESAR Solutions #32 and #33.

1.6 Glossary of terms

This section identifies useful terms for the comprehension of the document. The source of the definition is identified in the last column. The SESAR ATM lexicon [4] and the ATM Master Plan [6] are considered as the reference material. If needed, additional material to the reference definition is provided with the identification of the source.

Term	Definition	Source
Airspace Configuration	Is a pre-defined and coordinated organisation of ATS routes of the ARN and/or terminal routes and their associated airspace structures, including airspace reservations/restrictions (ARES), if appropriate, and ATC sectorisation.	**P07.02**
Airspace Management	Airspace Management is the process by which airspace options are selected and applied to meet the needs of the ATM community.	**ICAO Doc 9854 [15]**
	Airspace Management is integrated with Demand and Capacity Balancing activities and aims to define, in an inclusive, synchronised and flexible way, an optimised airspace configuration that is relevant for local, sub-regional and regional level activity to meet users' requirements in line with relevant performance metrics. Airspace Management primary objective is to optimise the use of available airspace, in response to the users demands, by dynamic time-sharing and, at times, by the segregation of airspace among various airspace users on the basis of short-term needs. It aims at defining and refining, in a synchronised and a flexible way, the most optimum airspace configuration at local, sub-regional and regional levels in a given airspace volume and within a particular timeframe, to meet users requirements while ensuring the most performance of the European Network and avoiding as much as possible any disruption. Airspace Management in conjunction with AFUA is an enabler to improve civil-military co-operation and to increase capacity for the benefit of all users.	**P07.02** **P04.02**

Term	Definition	Source
Airspace Reservation / Restriction	Airspace Reservation means a defined volume of airspace temporarily reserved for exclusive or specific use by categories of users (TSA, TRA, CBA) and Airspace Restriction designates Danger, Restricted and Prohibited Areas.	**WP B04.02 CONOPS Step 1 [7]**
	'Airspace reservation' means a defined volume of airspace temporarily reserved for exclusive or specific use by categories of users; 'Airspace restriction' means a defined volume of airspace within which, variously, activities dangerous to the flight of aircraft may be conducted at specified times (a 'danger area'); or such airspace situated above the land areas or territorial waters of a State, within which the flight of aircraft is restricted in accordance with certain specified conditions (a 'restricted area'); or airspace situated above the land areas or territorial waters of a State, within which the flight of aircraft is prohibited (a 'prohibited area')	**EC Regulation n°2150/2005**
Air Traffic Control Clearance	Authorisation for an aircraft to proceed under conditions specified by an air traffic control unit. Note: For convenience, the term "air traffic control clearance" is frequently abbreviated to "clearance" when used in appropriate contexts. The abbreviated term "clearance" may be prefixed by the words "taxi", "take-off", "departure", "en route", "approach" or "landing" to indicate the particular portion of flight to which the air traffic control clearance relates. Note: they can be delivered by voice or data link.	**ICAO Doc 4444 [17]**
Air Traffic Control Instruction	Directives issued by air traffic control for the purpose of requiring a pilot to take a specific action	**ICAO Doc 4444 [17]**
Air Traffic Flow and Capacity Management	A service complementary to Air Traffic Control (ATC), the objective of which is to ensure an optimum flow of air traffic to or through areas within which traffic demand at times exceeds the available capacity of the ATC system.	**ATM lexicon**
Area of Interest	The airspace encompassing the AoR and a defined buffer zone within which airspace status and flight information are of operational interest to the system operators.	**ATM lexicon**
Area Of Interest (IOP)	The volumetric extension of the AOR of an ATSU that allows detecting flights of interest for this ATSU. It is typically conditioned by the need of tactical control, i.e. capability of controllers to mentally integrate the traffic and functions like MTCD. It may additionally include specific rules based on traffic flows. There are as many AOI as there are ATSUs the associated system instance of which is an IOP stakeholder.	**EUROCAE ED-133 [9]**

Term	Definition	Source
Area navigation (RNAV)	Method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these. *Note.— Area navigation includes performance-based navigation as well as other RNAV operations that do not meet the definition of performance-based navigation*	**ICAO Doc 9613** **PBN Manual [16]**
Business / Mission Trajectory	A trajectory which expresses the business or mission intentions of the airspace user (respectively mainline, regional, business, general or military aviation). It includes both surface and airborne segments and is built from, and updated with the most timely and accurate data available in the Network Operations Plan (NOP), including turn-around elements.	**ATM lexicon**
Complexity	In the ATM context, traffic complexity refers to the number of simultaneous or near- simultaneous interactions of trajectories in a given volume of airspace. Note: As there are additional factors that construct complexity on the top of the simultaneous and near simultaneous number of interactions (most simple ones being: weather, mixture of traffic, coordination conditions), which don't appear in this definition, the 4.2 Step 1 DOD suggests to define complexity as measure of the difficulty that a particular traffic situation will present to an air traffic controller.	**ATM lexicon** **Note from P04.02**
Complexity Management	Assessment and resolution of complexity problems within the given constraints is called Air Traffic Complexity Management. It is performed by the Network Management function in strong coordination with the Extended ATC planning function by managing and balancing controllers' workload to achieve the goal of maximising the throughput of the ATM system, by not wasting, or leaving unused, any latent capacity, and of reducing safety risks related to workload variations.	**P04.02**
Complexity Assessment and Resolution Service	Complexity Assessment and Resolution Service represents a dynamic, automated service which applies a complexity function using metrics, within a defined airspace of operation in order to predict future controller workload within the appropriate look-ahead time horizon. This horizon is directly dependant on trajectory prediction (TP) accuracy and the level of capability and interoperability of ATM systems and tools.	**P04.02**
Complexity metric	It determines workload for a prescribed sector and a prescribed air traffic situation. Complexity metric can be based on different methodologies which are best suited for the local ATM environment. It is important that the outcome results are useable at network level and that the methodology is transparent.	**P04.02**

Term	Definition	Source
Conditional Route	An ATS route that is only available for flight planning and use under specified conditions. A Conditional Route may have more than one category, and those categories may change at specified times: a) Category One - Permanently Plannable CDR: CDR1 routes are available for flight planning during times published in the relevant national Aeronautical Information Publication (AIP). b) Category Two - Non-Permanently Plannable CDR: CDR2 routes may be available for flight planning. Flights may only be planned on a CDR2 in accordance with conditions published daily in the CRAM, and c) Category Three - Not Plannable CDR: CDR3 routes are not available for flight planning; however, ATC Units may issue tactical clearances on such route segments.	**ATM lexicon**
Conflict	Converging of aircraft in space and time which constitutes a predicted violation of a given set of separation minima.	**ATM lexicon**
Direct Routing	The shortest connection close to the great circle between 2 published waypoints consisting of a succession of Direct Segments and ATS route segments[2].	**Derived from SJU Free Route Task Force final report [26]**
Direct Routing Airspace	Airspace defined laterally and vertically with a set of entry/exit conditions where published direct routings are available. Within this airspace, flights remain subject to air traffic control.	**SJU Free Route Task Force final report [26]**
Direct Segment	A published segment of a great circle between 2 published waypoints, not being on a same segment of an ATS route and with published conditions of use.	**Derived from SJU Free Route Task Force final report [26]**
Encounter	A situation where an aircraft is predicted to be below the applicable separation of interest with respect to another aircraft, or a designated volume of airspace, classified respectively as “aircraft-to-aircraft” and “aircraft-to-airspace” encounters. Notes: Encounters are related to the various detection tools and may work to different look-ahead time horizons with different separation criteria, using different trajectories. Different tool configurations can therefore be expected to yield to different encounters. The Separation of Interest thresholds are considered with respect to any applicable uncertainty volumes around the predicted aircraft position(s).	**P04.07.02 OSED [32]**

[2] ICAO PANS-ATM [17] defines an ATS route as: “A specified route designed for channelling the flow of traffic as necessary for the provision of air traffic services.”

Term	Definition	Source
En Route phase	That part of the flight from the end of the take-off and initial climb phase to the commencement of the approach and landing phase.	**ATM Lexicon**
ETA min/max	ETA min/max is the earliest/latest ETA at a waypoint, provided that the aircraft flies the 4D trajectory at its max/min allowable speed, wind/temp error is also taken into account, in order to guarantee that any CTA defined within associated ETA min/max interval will be satisfied with a high probability.	**ATM lexicon**
Extended ATC Planning	An ATC planning role, involved in organising air traffic by managing individual iRBTs/iRMTs or traffic flows in a Sector Family within ATSU airspace. Depending on the ATSU environment and operational working methods the actor performing the Extended ATC planning would serve several operational sectors in order to insure execution of iRBTs/iRMTs with minimum deviation while maintaining Sector Team workload at optimum level and facilitating network generated tasks at the same time.	**P04.02**
Flight Object	The system instance view of a flight. It is the Flight Object that is shared between the IOP stakeholders. Note: The 'Flight Object' (FO) is a concept to support the sharing of consistent flight data between all ATM stakeholders.	**ATM lexicon** **Note from P04.02**
Free Routing	The ability of an Airspace User to plan/re-plan route according to the user-defined segments.	**SJU Free Route Task Force final report [26]**
Free Routing Airspace	Airspace defined laterally and vertically, allowing Free routing with a set of entry/exit features. Within this airspace, flights remain subject to air traffic control	**SJU Free Route Task Force final report [26]**
Functional airspace block (FAB)	An airspace block which is established regardless of State boundaries and is based on common operational requirements, where the provision of air navigation services and related functions are performance-driven. The services are also optimised with a view to promoting, enhanced cooperation among air navigation service providers or, where appropriate, an integrated provider. The FABs are put in place by the European Commission in the framework of the Single Sky.	**ATM lexicon**
Ground-Ground interoperability (GG-IOP)	Any Interoperability needed between ground units for the purpose of negotiating, and sharing the various data	**P04.02**
4-Dimensional Trajectory	A set of consecutive segments linking waypoints and/or points computed by FMS (airborne) or by TP (ground) to build the vertical profile and the lateral transitions; each point defined by a longitude, a latitude, a level and a time.	**ATM Lexicon**

Term	Definition	Source
Initial 4-Dimensional Trajectory (i4D) operations	Initial 4D operation is limited to the sharing of on-board 4D trajectory data with the possibility for application of a single time constraint (only one constraint at a given time) at a specific point. This includes monitoring of the trajectory and its conformance with the assigned constraint.	**P04.02**
Navigation specification	A navigation specification is a set of aircraft and aircrew requirements needed to support a navigation application within a defined airspace concept. The navigation specification: - defines the performance required by the navigation system, - prescribes the performance requirements in terms of accuracy, integrity, continuity and availability for proposed operations in a particular Airspace, - also describes how these performance requirements are to be achieved i.e. which navigation functionalities are required to achieve the prescribed performance and associated requirements related to pilot knowledge and training and operational approval. A Performance-Based Navigation Specification is either a RNAV specification or a RNP specification. RNAV specifies a required accuracy whilst RNP specifies, in addition to a required accuracy, an aircraft system alert in case of deviation, with the pilot responsible to remain the aircraft within the RNP accuracy; it allows reducing ATC buffer with the controller still responsible for the separation against traffic.	**ICAO Doc 9613** **WP B04.02 CONOPS Step 1 [7]**
Network Management	Network Management is an integrated activity with the aim of ensuring optimised Network Operations and ATM service provision meeting the Network performance targets., The Network Management Function is executed at all levels (Regional, Sub-regional and Local) throughout all planning and execution phases, involving, as appropriate, the adequate actors (NM, FM, LTM…)	**P07.02** **P04.02**
Network Operations Plan (NOP)	A set of information and actions derived and reached collaboratively and both relevant to, and serving as a reference for, the management of the Pan-European network in different timeframes for all ATM stakeholders, which includes, but is not limited to, targets, objectives, how to achieve them and anticipated impact. The NOP has a dynamic and rolling lifecycle starting in the strategic phase and progressively updated up to and including the execution and post-operations phases. Note: It supports and reflects the result of the collaborative ATM planning process: at each phase, stakeholders collaborate in developing a common view	**ATM lexicon**

Term	Definition	Source
	of the planned network situation, allowing each of them to take informed decisions considering the network effect and the Network Manager to ensure the overall coordination of individual decisions needed to support network performance.	
Performance-Based Navigation	Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace. Note.— Performance requirements are expressed in navigation specifications in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept	**ICAO DOC 9613** **PBN Manual**
Reference Business/Mission Trajectory **Initial Reference Business/Mission Trajectory**	The business/mission trajectory which the airspace user agrees to fly and the ANSP and Airports agree to facilitate (subject to separation provision). An extended flight plan, with trajectory data which is the result of the collaborative planning process that develops and establishes agreement for the iSBT/SMT. It is published immediately prior to the execution phase. It initially contains all of the data included in the agreed iSBT/SMT, (including key elements of the routing and timings, such as agreed targets (TTO/TTA)). It may be refined, updated or revised during the execution phase.	**ATM lexicon** **P04.02 for Step 1 (iRBT/iRMT)**
Revision of the iRBT/iRMT	The revision of the initial Reference Business or Mission Trajectory (iRBT/iRMT) is launched when there is a need for human intervention to change the route and/or altitude/ Flight Level and/or time features (Targets and/or Constraints), It is mostly triggered at Controller or Flight Crew initiative but it may also be initiated by other ground actors (LTM, FOC/WOC…). However, iRBT/iRMT revisions can only be implemented by ATCOs and the Flight Crew. Revisions are launched only when duly required, mainly due to hazards (traffic, weather), or inability for the aircraft system to meet a constraint/target (e.g. missed CTA) or fine sequencing (CTA or CTO allocation) or business needs.	**P04.02 for Step 1**
Route Availability Document (RAD)	The RAD is a common reference document containing the policies, procedures and description for route and traffic orientation. It also includes route network and free route airspace utilisation rules and availability.	**European Route Network Improvement Plan [10]**

Term	Definition	Source
Safety Net (Ground based and airborne)	An airborne and/or ground based function within the ATM system whose sole purpose is to alert aircrew/ATCO of the imminence of a hazardous situation (e.g., risk of aircraft collision, terrain collision, or airspace penetration) so that it can be resolved in a timely manner.	**ATM lexicon**
Shared Business/Mission Trajectory **Initial Shared Business/Mission Trajectory**	Published Business/Mission trajectory that is available for collaborative ATM planning purposes. The refinement of the SBT/SMT is an iterative process. An extended flight plan, with trajectory data (as specified for UP4DT/ReqMT) for use in the period leading up to the execution phase of the flight. It Incorporates flight intentions which are progressively refined with information provided by the Airspace users. The initial SBT/SMT available in Step 1 will only reflect the medium-term planning.	**ATM lexicon** **P04.02 for Step 1 (Initial SBT/SMT)**
Short Term ATFCM Measures	An approach to smooth sector workloads by reducing traffic peaks through short-term application of minor ground delays, appropriate flight level capping and exiguous rerouting to a limited number of flights. These measures are capable of reducing the traffic complexity for ATC with minimum curtailing for the airspace users. STAM is based on high-quality data for prediction and accurate traffic analysis and will be an important contribution to dynamic DCB.	**WP B04.02 Step 1 CONOPS [7]**
Trajectory Adjustment through Constraint of Time (TRACT)	The TRACT tool (formerly TC-SA) performs early conflict resolution through the allocation of CTO to appropriate aircraft over the conflict point. The concept has to be applicable under the condition that it implies minimum or no speed adjustment to the involved aircraft in order to preserve as much as possible the optimum flight profile.	**WP B04.02 Step 1 CONOPS [7]**
Update of the iRBT/iRMT	A trajectory update implies an Air-Ground and/or Ground-Ground trajectory distribution. The update of the iRBT/iRMT is triggered automatically, on request or periodically. The update of the initial Reference Business or Mission Trajectory (iRBT/iRMT) is automatically triggered when the trajectory predictions continuously computed by the ground and/or aircraft system(s), differ from the previously shared trajectory predictions by more than a defined threshold.	**P04.02 for Step 1**

Term	Definition	Source
User defined segment	A segment of great circle connecting any combination of two user-defined or published waypoints.	**SJU Free Route Task Force final report [26]**
User Preferred Route	A User Preferred Route (UPR) is defined during planning phase by the Airspace User, which expresses his Business / Mission intentions. The UPR describes the entire airborne phases of the flight. The Airspace Users are free to define UPR taking into account the network constraints already defined and shared. The User Preferred Route may include: - a part freely defined in Free Route Airspace, - a part chosen among a set of several available published routes (direct or not) outside the Free Route Airspace - the description of the related transition phases - cruising, climbing and descending profiles The User Preferred Trajectory computed from the UPR is published by the Airspace User for collaborative ATM planning purposes as Shared Business / Mission Trajectory.	**SJU Free Route Task Force final report [26]**
User Preferred Trajectory	The user preferred trajectory is the trajectory initially provided by the Airspace User; during planning phase, it may be amended by the AU to integrate ATM constraints from DCB (e.g. airspace reservations, capacity short falls) resulting from iterative SBT/SMT and RBT/RMT agreement; alternate user preferred trajectories may be associated to the RBT/RMT to face pre-defined scenarios; in execution phase, it may be revised to integrate new ATM constraints from dynamic DCB (e.g. new or revised airspace reservations, capacity short falls) involving the AU to provide the user preferred trajectory solution integrating the new ATM constraints.	**WP B04.02 Step 1 CONOPS [7]**

1.7 Acronyms and Terminology

Term	Definition
5LNC	Five-Letter Name Code
ACARS	Aircraft Communication Addressing and Reporting System
ACAS	Airborne Collision Avoidance System
ACC	Area Control Centre
ADD	Architecture Definition Document
AFUA	Advanced Flexible Use of Airspace
AIP	Aeronautical Information Publication
AMA	AMC Manageable Area
AMAN	Arrival Manager
AMC	Airspace Management Cell
ANSP	Air Navigation Service Provider
AoI	Area of Interest
AoR	Area of Responsibility
APW	Area Proximity Warning
ARES	Airspace Reservation
ARN	ATS Route Network
A-RNP	Advanced-RNP (Required Navigation Performance)
ASM	Airspace Management
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
ATS	Air Traffic Services
ATSU	Air Traffic Service Unit
AU	Airspace User
AUP/UUP	Airspace Use Plan / Updated Use Plan
BT	Business Trajectory
CBA	Cross Border Area
CDM	Collaborative Decision Making
CDR	Conditional Route
CD/R	Conflict Detection and Resolution
CDT	Conflict Detection Tool

Term	Definition
CONOPS	Concept of Operations
COP	CO-ordination Point
CORA	COnflict Resolution Assistant
CTO	Control Time Over
CWP	Controller Working Position
DCB	Demand Capacity Balancing
DCT	Direct (in flight plan)
dDCB	Dynamic DCB
DFL	Divisional Flight Level
DMAN	Departure Manager
DOD	Detailed Operational Description
DRA	Direct Routing Airspace
eAMI	Electronic Airspace Management Information
EAP	Extended ATC Planner
E-ATMS	European Air Traffic Management System
EATMA	European ATM Architecture
ECAC	European Civil Aviation Conference
ERNIP	European Route Network Improvement Plan
ESRA	EUROCONTROL Statistical Reference Area
ETFMS	Enhanced Tactical Flow Management System
FAB	Functional Airspace Block
FBZ	Flight plan Buffer Zone
FDPS	Flight Data Processing System
FIR	Flight Information Region
FL	Flight Level
FLOS	Flight Level Orientation Scheme
FMS	Flight Management System
FO	Flight Object
FOC	Flight Operation Centre
FPL	Flight PLan
FRA	Free Routing Airspace
FRT	Fixed Radius Turn
FUA	Flexible Use of Airspace
GAT	General Air Transport
IFPS	Integrated initial Flight Plan Processing System

Term	Definition
IFR	Instrument Flight Rules
INAP	Integrated Network management and extended ATC Planning
INTEROP	Interoperability Requirements
IOP	Interoperability Protocol
iRBT	Initial RBT
iSBT	Initial SBT
KPA	Key Performance Area
KPI	Key Performance Indicator
LoA	Letter of Agreement
MET	Meteorology
MONA	MONitoring Aids
MT	Mission Trajectory
MTCD	Medium-Term Conflict Detection
NA	Not Applicable
NEFRA	North European Free Route Airspace
NM	Network Manager
NMF	Network Management Function
NMOC	Network Manager Operations Centre
NOP	Network Operations Plan
NOTAM	Notice to Airmen
OAT	Operational Air Transport
OCD	Operational Concept Description
OFA	Operational Focus Areas
OI	Operational Improvement
OLDI	On-Line Data Interchange
OSED	Operational Service and Environment Definition
P&S	Processes & Services
PBN	Performance-Based Navigation
PC	Planning Controller
PCP	Pilot Common Project
PDR	PreDetermined Route
RA	Resolution Advisory
RAD	Route Availability Document
RBT	Reference Business Trajectory
RMT	Reference Mission Trajectory

Term	Definition
RNAV	Area Navigation
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SPR	Safety and Performance Requirements
STAM	Short Term ATFCM Measures
STAR	Standard Terminal Arrival Route
STCA	Short-Term Conflict Alert
SYSCO	SYstem Supported CO-ordination
TC	Tactical (or Executive) Controller
TCT	Tactical Controller Tool
TMA	Terminal Manoeuvring Area
TMF	Trajectory Management Framework
TSA/TRA	Temporary Segregated Area/ Temporary Restricted Area
TTA	Target Time of Arrival
TTO	Target Time Over
UIR	Upper flight Information Region
UPR	User Preferred Route
UPT	User Preferred Trajectory
UTC	Universal Time Coordinated
VPA	Variable Profile Area
WOC	Wing Operation Centre

2 Summary of Operational Concept (from OSED)

2.1 Description of the Concept Element

This section provides a summary of the Free Route Concept Element described in the Free Route OSED for Step 1 [33] with a focus on the SESAR Solutions #32 and #33.

These Solutions are covering the operational needs for Airspace Users and ATS Providers to support safe and efficient Direct Routing operations across ACC/FIR borders and in high complexity environments (Solution #32) and Free Routing operations across ACC/FIR borders within permanently low to medium complexity environments (Solution #33).

It should be noted that other Free Route concepts elements (such as Use of Performance Based Navigation (PBN) for separation purpose in Free Route airspace, Enhanced ATFCM processes[3] to manage air traffic flows and airspace capacity in support to Free Route operations or Procedures for the revision of LAT, LON trajectories inside FRA) still need more work to reach a V3 maturity level (and are therefore not part of the SESAR Solutions #32 and #33).

2.1.1 Free Route Concept

As per the EU Regulation No 716/2014 on the establishment of the Pilot Common Project (PCP) supporting the implementation of the European ATM Master Plan, and its third ATM Functionality (#AF3) related to Flexible Airspace Management and Free Route, the "*combined operation of Flexible Airspace Management and Free Route enable airspace users to fly as closely as possible to their preferred trajectory without being constrained by fixed airspace structures or fixed route networks*."

"*Free Route may be deployed both through the use of Direct Routing Airspace and through FRA. [...] To facilitate early implementation before the target deployment date [...], free route could be implemented in a limited way during defined periods*."

The term "Free Route" is a high level title under which two distinct instantiations of implementation can occur. Thus, distinction is to be made between "Direct Routing" and "Free Routing" operations. This distinction enables a significantly increased level of clarity around what is actually being implemented.

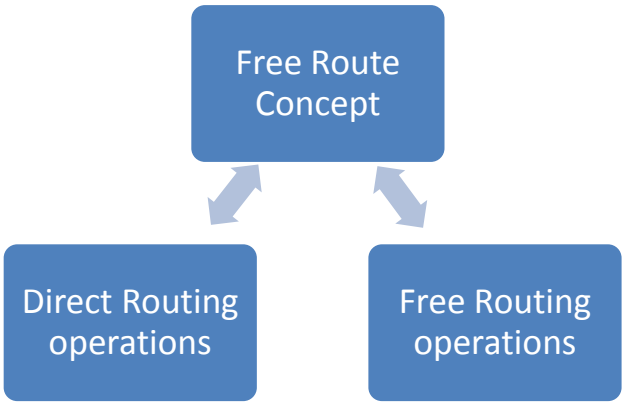

Figure 2: Free Route concept elements

The User Preferred Route (UPR) may depend on various factors affecting the efficiency and/or cost-effectiveness of the flights (e.g. adverse weather / winds / ATC delays, costs / etc.). It should also be noted that the UPR also exists in ATS Route Network environment and is not discriminating the part of the route inside Direct Routing Airspace or Free Routing Airspace. The User Preferred Trajectory

computed from the UPR is published by the Airspace User for collaborative ATM planning purposes as Shared Business / Mission Trajectory.

"*Combined operation of Flexible Airspace Management and Free Route enable airspace users to fly as closely as possible to their preferred trajectory […]. It further allows operations that require segregation, for example military training, to take place safely and flexibly, and with minimum impact on other airspace users.*"

The Free Route concept is indeed based on a common understanding between civil and military airspace users, civil ANSPs and military ATS and Air Defence units. This common understanding is the first step towards a harmonised Free Route implementation that will provide operational and cost benefits to the airspace users. Safety shall be at least maintained and necessary safety assessment(s) shall be performed (by civil and military units) according to the requirements of competent national authorities.

The implementation of the Free Route concept shall not adversely affect the requirements from military airspace users in terms of access to airspace for military training purposes. Military Air Operations will be accommodated in DRA and FRA utilizing the AFUA concept[4].

2.1.2 Free Route SESAR Solutions and Operational Improvements

The Free Route concept is divided into two OI Steps in Step 1 (see DS16 [18] for details), i.e.

- Direct Routing for flights both in cruise and vertically evolving for cross ACC borders and in high complexity environments [AOM-0500], seen as an early iteration of the Free Route concept in Step 1,
- Free Routing for flights both in cruise and vertically evolving within low to medium complexity environments [AOM-0501], seen as an initial iteration of the Free Routing concept in Step 1.

These OI Steps are followed by more demanding OI Steps in Step 2 (see DS16 [18] for details) which will be progressed within SESAR 2020, i.e.

- Free Routing for flights both in cruise and vertically evolving within high complexity environments in Upper En Route airspace [AOM-0505], and
- Free Routing for flights both in cruise and vertically evolving within high-complexity environments in Lower En Route airspace [AOM-0506],

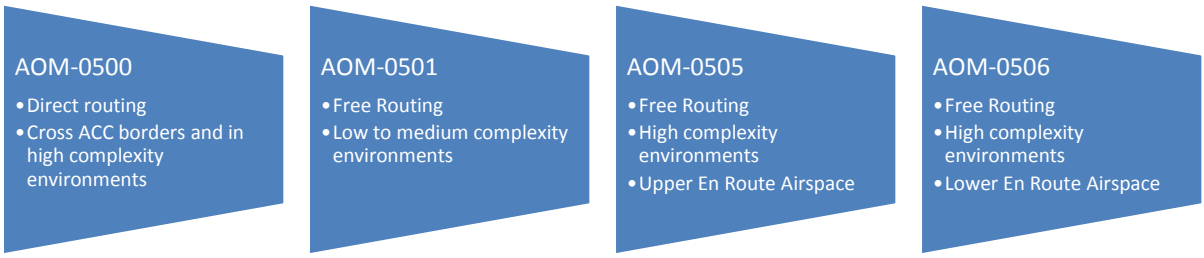

Figure 3: Free Route related OI Steps

The Step 1 OI Step [AOM-0500] aims at enlarging today's Free Route initiatives (which mainly rely on the concept of published En-route Directs (DCTs) made available at the planning phase in accordance with FUA principles) to larger and more complex En-Route environments with AFUA, Enhanced Dynamic Demand Capacity Balancing (dDCB) including Complexity Management, and Enhanced ATC Conflict Management and Automation.

[4] *The concept of AFUA intends to provide more flexibility by allowing dynamic airspace management in all phases of the operations, from initial planning to the execution phase, taking into account local traffic characteristics. The aim is to establish a coherent collaborative decision making process supported by ASM systems to bring planning and execution phase closer together and to make them consistent and transparent.*

The **SESAR Solution #32 contributing to [AOM-0500]** is focused on the operational needs for Airspace Users and ATS units to support safe and efficient Direct Routing operations across ACC/FIR borders and in high complexity environments. This Solution is an extension of the baseline concept of published En-Route DCTs (Directs) for seamless operations in Direct Routing environment or Airspace defined at a large geographical scale.

The Step 1 OI Step [AOM-0501] aims at enlarging the previous OI Step [AOM-0500] to the possibility to plan flights along User Preferred Routes including a part freely defined in Free Route Airspace of low to medium complexity and managed in accordance with AFUA principles.

The **SESAR Solution #33 contributing to [AOM-0501]** is focused on the operational needs for Airspace Users and ATS units to support safe and efficient Free Routing operations across ACC/FIR borders within permanently low to medium complexity environments. This Solution is an initial step towards the whole concept of Free Routing, i.e. the ability of an Airspace User to plan/re-plan route according to user-defined segments within significant blocks of Free Routing Airspace. It applies to low to medium complexity environments with limited variability in traffic complexity.

The **SESAR Solutions #32 and #33** have the same overall objective, i.e. provide the opportunity to airspace users to plan flight (and fuel) for optimal routes above a certain flight level, with increased expected benefits at each step (thanks to an increased applicability of the Free Route concept in Europe). In order to gain full benefits from its applicability, the vertical and horizontal limits of Free Route operations should be based on operational requirements and not necessarily on FIR/UIR or ATS Unit boundaries.

2.1.3 Direct Routing across ACC/FIR borders and in high complexity environments

Direct Routing into high complexity environments [AOM-0500] is one alternative of the Free Route concept in Step 1. This OI Step is an extension of the concept of published En-Route DCTs (Directs) across ACC/FIR boundaries in **Direct Routing environment or Airspace**.

Direct Routing in high complexity environments aims at offering Airspace Users an airspace volume where the network of **Direct Routings** is optimised enabling maximisation of flexibility in flight planning. The significant number of Direct Routings is part of the environment complexity.

Direct Routing Airspace refers to an airspace defined laterally and vertically with a set of entry/exit conditions where published direct routings are available.

Within this airspace, flights remain subject to air traffic control.

For maximum benefits, the optimised Direct Routing network should be determined depending on the demand (from AUs). The optimised Direct Routing Network would increase flexibility in flight planning to AUs by offering them more possibilities to find the closest trajectory to their User-Preferred one and offering geographically enlarged optimised trajectory.

When designing the Direct Routing network the Variable Profile Area (VPA) design principle should be considered in order to allow management of flexible modules tailored to individual mission objectives and available direct routes around defined Airspace Reservation (ARES) configuration. This will offer Direct Routing Planning Options to Airspace Users with a maximum availability time during military operating hours of military areas.

The optimal design options for Direct Routing Network will be then constituted by some large geographical scale Direct Routings structured along major traffic flows with connectivity ensured along the segments (so-called **Long Range Direct Routings**) and/or by many shorter Direct Routings that can be freely combined by AUs to optimise their planned trajectories. Long-range Direct Routings means that there is a FAB-wide cross-border dimension in most of them. Intermediate waypoints are allowed and can be used for instance to join/leave Long Range Direct Routings or to design Direct Routings avoiding ARES.

The condition of use of Direct Segments constituting the Direct Routing Network shall be kept as simple as possible in order to make the Route Availability Document (RAD) constraints manageable by airspace users. The number of short Direct Segments shall also be kept to a manageable level to avoid a possible flight planning issue (from AU's perspective) if too many short DCTs with conditions

of use are published (through RAD) for the whole European airspace. This may create a human resource issue for managing many Direct Segments at AUs level. Also there might be a computation time issue for the flight planning systems if the Direct Routing network is too complicated.

With regard to optimum Direct Segment length from Flight Operation Centre/Aircraft perspectives, a first guess is that short direct segments should allow both efficient flight planning and safe flight monitoring during the execution phase.

2.1.4 Free Routing across ACC/FIR borders within permanently low to medium complexity environments

Free Routing into low & medium complexity environments [AOM-0501] is another alternative of the Free Route concept in Step 1. This OI Step is an initial step towards the concept of **Free Routing**, i.e. the ability of an Airspace User to plan/re-plan route according to the user-defined segments within significant blocks of **Free Routing Airspace** (across ACC/FIR boundaries).

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). Any combination then could be a segment connecting:

- User defined waypoint & User defined waypoint
- User defined waypoint & published waypoint
- Published waypoint & published waypoint

Free Routing Airspace (FRA) is an “Airspace defined laterally and vertically, allowing Free routing with a set of **entry/exit features**.”

Within this airspace, flights remain subject to air traffic control.

In Free Routing Airspace, experience from today’s operational FRA environments shows that the main difference will be that the ATC way of working during the execution phase will be less structured and much more flexible. Within Free Routing Airspace, traffic will not enter or leave the sector at specific COPs, and conflicts could appear anywhere within the sector as a result of removing predefined crossing points existing in the ARN. The trajectories will vary from day to day, and not follow a specific pattern, which might increase the complexity at sector/ATSU level particularly in case of Free Routing operations across ACC/FIR borders; but this might also lead to improvements for ATCOs as several aircraft can be kept in the same flight level as they are spread over a wider area assuming that no major flow convergence phenomena would remain after adequate ATFCM.

ATC system needs to handle user-defined trajectories, possibly using LAT,LON points, and to support ATSU/sector coordination without the use of specific COPs. Revision to any coordination needs to automatically update the trajectory, revise and notify the downstream sector. As a result of better trajectory/FPL compatibility the number of revisions is likely to decrease, as fewer tactical directs are expected.

FRA will demand a more flexible way of working, and it is almost a paradigm shift in ATCO’s everyday life, which needs to be supported by a set of advanced tools. Due to the fact that traffic flows probably will change their geographical location, there might be a need to redesign airspace and sector configurations accordingly.

If tactical intervention to traffic is needed, the ATCO would need to know the next FPL significant point to clear back the aircraft on its planned trajectory. In case of FRA operations at a large geographical scale, to avoid the next FPL significant point to be very far away (and outside the database of the local ATC system), one possibility could be to put a limitation on maximum segment length in FRA. This would provide a possibility to re-join the trajectory at the next Intermediate point. ICAO recommends 200 NM as maximum length between successive waypoints in FPL (see Appendix 2 ITEM 15: ROUTE of ICAO PANS-ATM [17]), which might be a suitable solution.

2.2 Description of Operational Services

In the absence of any modelling of the Processes & Services (P&S) related to Free Route in the SESAR European ATM Architecture (EATMA) V7 [19], this section provides a brief description of the

existing operational Processes related to Airspace User, Network and ATS Operations which are considered relevant for the Free Route SESAR Solutions.

Note to the reader: This section also contains a comprehensive list of assumptions related to Network Management operations (which are out of scope of the SESAR Solutions #32 and #33).

These assumptions (that use the operative verb "**will**") are considered as "Essential" to support the safe and efficient deployment of the Solutions.

It has been adopted the same principles to identify the Assumptions than for the Safety and Performance Requirements in section 3, except that the Identifier prefix is set to "ASS-04.07.02-SPR-"and that the Reference number is as follows:

- XXYY: Reference number defined as a sequence of four digits, the two first digits indicating it is an assumption and the two last being an increment in the numbering, i.e.
  - XX:
    - 01 for all assumptions
  - YY: Incremented for each assumption

2.2.1 Services related to Airspace User Operations

In the absence of any modelling of the Services related to Free Route in EATMA V7 [19], the following table describes the Business and Mission Trajectory Management processes related to Airspace User Operations which are of interest for Free Route operations.

Process Id and Title	Description	Relationship with Free Route
Business and Mission Trajectory		
BT in Medium/ Short Term	-	Also applicable to Free Route environments including flight planning in DRA/FRA Civil AUs systems are already able to accommodate Flight Planning associated to the various initial DCTs/FRA initiatives throughout Europe. Nevertheless, an efficient Flight Planning management might be challenged by the extension of todays' Free Route operations through the entire ECAC. The direct routings should be published in a more manageable way than what is done today (and particularly, with regard to the DCT limits of use defined in the Route Availability Document (RAD) published by the Network Manager. Moreover, in order to ease Flight Operation Centre (FOC) operations, it should be provided a common set of rules (e.g. FRA definitions, FRA constraint definitions) for the entire Free Route operations through ECAC.
MT in Short Term	This functional process includes filing, submission, validation and distribution of an improved OAT Flight Plan through Network Management (NM).	Also applicable to Free Route environments for OAT flight planning in DRA/FRA State AUs are already able to accommodate Flight Planning associated to the various initial DCTs/FRA initiatives throughout Europe. For military flights subject to flight planning, all available design options such as navigation points, entry/exit points, upper and lower limits of FRA/DRA airspace will facilitate optimisation of Mission trajectories hence increasing the

Process Id and Title	Description	Relationship with Free Route
		level of predictability. Nevertheless, an efficient Flight Planning management by the WOCs might be challenged by a significant increase of the direct routing number through Europe and more particularly by the complexity brought by the management of the conditional restrictions associated to these direct routings.
Trajectory Revision in Execution	-	Also applicable in Free Route environments However, AUs can expect to fly the user preferred trajectory as direct routings / user-defined segments will be available for planning (and use of tactical directs during the execution phase will be less frequently needed).

Table 1: Processes related to Airspace User Operations in Free Route

2.2.1.1 Assumptions relating to BT/MT Flight Planning Processing by Network Manager in Direct Routing environment

Identifier	ASS-04.07.02-SPR-DRFP.0101
Assumption	In planning phase, the Network Manager will invalidate (suspend or reject) FPLs with Direct Routings going through ARES planned to be active

Identifier	ASS-04.07.02-SPR-DRFP.0102
Assumption	In planning phase, the Network Manager will invalidate (suspend or reject) FPLs not compliant with condition of use of the direct segments

Identifier	ASS-04.07.02-SPR-DRFP.0103
Assumption	In planning phase, the Network Manager will invalidate (suspend or reject) FPLs not compliant with DRA availability

Identifier	ASS-04.07.02-SPR-DRFP.0104
Assumption	In planning phase, the Network Manager will invalidate (suspend or reject) FPLs not compliant with ATFCM restrictions applicable in direct routing environment

2.2.1.2 Assumptions relating to BT/MT Flight Planning Processing by Network Manager in Free Routing environment

Identifier	ASS-04.07.02-SPR-FPFP.0101
Assumption	In addition to normal SBT validation rules, the Network Manager will invalidate (suspend or reject) planned route inside a FRA if it: • Fails to comply with flight planning rules (e.g. published entry/exit requirements, min/max segment length, usable points) • Fails to comply with airspace time and volume availability (e.g. active ARES, volume-based ATFCM constraints)

Identifier	ASS-04.07.02-SPR-FPFP.0102
Assumption	In Free Routing Airspace, in case of rejection of a flight plan by IFPS, NM will provide the reason of the rejection

Identifier	ASS-04.07.02-SPR-FPFP.0103
Assumption	In Free Routing Airspace, the reason of IFPS rejection of flight plan will be understandable, machine readable and manageable by the airspace users (e.g. volume to be avoided)

Identifier	ASS-04.07.02-SPR-FPFP.0104
Assumption	In Free Routing Airspace, in case of rejection of a flight plan by IFPS, NM will provide a proposal of rerouting for the airspace users in a timely manner

2.2.2 Services related to Airspace Organisation and Management

In the absence of any modelling of the Services related to Free Route in EATMA V7 [19], the following table describes the Airspace Management processes related to Network Operations which are of interest for Free Route operations. The relationship with Advanced Flexible Use of Airspace (AFUA) is also described.

Process Id and Title	Description	Relationship with Free Route
Plan & Implement Airspace Design	This corresponds to the airspace design taking into account international procedures and specifications as well as Airspace User requirements and afterwards implementation of new airspaces, e.g. new sectorisations, new routes.	Also applicable to Free Route environments with regard to DRA/FRA airspace design The Airspace Data Repository (ADR) has to accommodate the changes in airspace design, organisation and management associated with Direct Routing and Free Routing Airspace. Rules for the design of FRA, DRA and direct routings have to be defined, and commonly agreed, for effective AU, NM and ATS operations. Applicable rules for user-defined segments inside FRA have to be defined, and commonly agreed, for effective AU, NM and ATS operations. ATC sector design has to be adapted to direct routing and free routing operations.
Plan Network Airspace Architecture	Planning of the Network Airspace Architecture (taking into account civil and military needs, ICAO regional plans, aircraft fleet capabilities, air and ground navigational capabilities etc.)	Also applicable to Free Route environments with regard to DRA/FRA airspace design
Plan Network Management Operations	Elaboration of the Network Operations Plan (NOP), which is built in the planning phase initially as a result of analysing the plans of partners as well as requests from Airspace Users.	Also applicable to Free Route environments with regard to DRA/FRA airspace management Network Operations Plan (NOP) has to accommodate the Direct Routing and Free Routing operations, notably through enriched data sharing related to ATFCM/ASM (e.g. to accommodate cross-border activities).
Advanced Flexible Use of Airspace	-	Also applicable to Free Route environments with regard to ARES management inside DRA/FRA

Table 2: Processes related Airspace Management in Free Route

Both DRA and FRA require Airspace Management (ASM), at Network Management level. There is a need to move away from providing airspace users with route availability information, associated with the current ATS Route Network, to the provision of airspace availability.

In order to enable DRA/FRA operations, the High-Level Airspace Policy Body will decide at local/sub-regional level on new airspace design and operational procedures. Therefore it implies that automation support will be given by ASM and NM systems taking into account level of complexity of such operations. ASM and ATFCM functions are integrated in order to better balance all AU demands within predefined airspace configuration scenario and reach the most efficient outcome of the collaborative decision making process.

The lack of ATS route network in FRA, and potentially in DRA, means that the management of reserved airspace availability requires change to local Airspace Management Cells (AMCs), ASM and ATFCM functions, and at the level of procedures, processes and systems. Both inputs and outputs will change. At NM level the changes are already taking place, such as agreement on the Flight plan Buffer Zone (FBZ), ongoing changes to the AUP/UUP process, ASM and ATFCM tools and RAD review. This means that the building blocks will be in place when large scale operations commence.

In FRA the AU needs to identify which airspace is reserved and flight plan accordingly. For Direct Routings in DRA the opening and closing of Direct segments may be linked to the availability of reserved airspace notification of changes will be incorporated into NMF systems and procedures.

Advanced Flexible Use of Airspace (AFUA) will be utilized to support more efficient use of airspace and facilitate the use of direct routings in DRA and of user-defined segments in FRA when the airspace is available. Data related to airspace configurations (including VPA design principle), airspace planning, dynamic management of airspace, and airspace status is shared by all ATM stakeholders in real time. Even if AFUA is not directly linked to FRA and DRA and will be applied in all En Route Airspace, it will allow more efficient direct routing and free routing operations.

Disclaimer: The above features are described here as part of the environmental aspect of direct routing and free routing implementation but are **out of scope of the SESAR Solutions #32 and #33** described in this document. These solutions are focused on the operational needs for Airspace Users and ATS units. Nevertheless, the assumptions related to airspace management at Network level in direct routing and free routing environments are listed hereafter.

2.2.2.1 Assumptions relating to Airspace Management by Network Manager in Direct Routing environment

No assumption relating to Airspace Management by NM for Direct Routings across ACC/FIR borders and in high complexity environments.

2.2.2.2 Assumptions relating to Airspace Management by Network Manager in Free Routing environment

Identifier	ASS-04.07.02-SPR-FRAM.0101
Assumption	NOP will contain the latest updated information on all planned and actual available airspace in Free Routing Airspace

2.2.3 Services related to Demand & Capacity Balancing

In the absence of any modelling of the Services related to Free Route in EATMA V7 [19], the following table describes the Air Traffic Flow and Capacity Management (ATFCM) processes related to Network Operations which are of interest for Free Route operations.

Process Id and Title	Description	Relationship with Free Route
Determine Network Demand	Split into 3 sub-processes: - Determine Network Demand - Medium Term	Also applicable to Free Route environments with regard to UPR demand inside DRA/FRA

Process Id and Title	Description	Relationship with Free Route
	- Determine Network Demand - Short Term - Determine Network Demand - Day of operation	NM systems are already capable to support Flight Planning in FRA/DRA, as they are already able to accommodate Flight Planning associated to the various initial DCTs/FRA initiatives throughout Europe. The NM Flight Plan processing system (IFPS) enables Flight plan processing in DRA and FRA (incl. when very long direct routings (across several ANSPs) are used). Support is provided to AUs to ease and optimize their use of direct routings.
Plan Network Resources and Capabilities	Define and update Network, Airport and ANSP Resources and Capabilities taking into account environmental data and publish in the NOP	Also applicable to Free Route environments including taking into account UPR inside DRA/FRA ATC sector configuration, as part of predefined airspace configuration scenario, will require to be adapted to traffic demand (more particularly in a FR environment where the traffic is likely to be more spread out in the airspace than in a DR environment with published direct routings)
Balance Demand with Resources and Capabilities	This process model is shared in two parts in order to ensure a better readability. The sharing is based on the activities chronology (from 6 months to 6 days before take-off and from 6 days before take-off till take-off). Management of Demand and Capacity imbalances at local/sub-regional/NM level (through DCB/dynamic DCB solution, airspace solution or crisis event management) in long, medium to short-term planning phase	Also applicable to Free Route environments including Plan Network Airspace Architecture related to DRA/FRA (with collaborative management and DCB)
Dynamically Balance Network Capacity with Demand	Management of Demand and Capacity imbalances (through dynamic DCB measure, dynamic airspace management or crisis event management) during execution phase	Also applicable Free Route environments for dynamic DCB in DRA/FRA Dynamic DCB (dDCB) is expected to benefit from the improved flight predictability as the result of aircraft trajectories closer to AUs business needs and reduced in-flight variability in both Direct Routing / Free Routing concepts and used as input for this service.

Table 3: Processed related to ATFCM at Network level in Free Route

To combine the flexibility offered to AUs with the requirements as defined by the ANSPs, it is foreseen that the strategic ATFCM process as administered by the Network Manager will change from being

route or segment based to being based on volume. How such volume-based approach to manage air traffic flows and airspace capacity in FRA still needs to be investigated.

The different approaches defined to assess complexity at NM level would need to be deeply analysed to be adapted to DR/FR environment.

The applicability of DCB (including STAM measures) as defined in ATS fixed route environment is to be further assessed for DRA/FRA environment. Some adapted procedures might be needed (more particularly in FRA environment) to deal with:

- the potential issue with re-routings in FRA. In this respect, the solution can either be to use the "avoid airspace" function and request AU's to re-plan trajectories or to upgrade NM systems to create routes using LAT,LON points but which will not be user-preferred routes. If tactical re-routing using LAT,LON routes is envisaged inside FRA, operational acceptability from AU's perspective would also need to be assessed.
- the adjustment of Occupancy Counts to "nuisance flows" in FRA;
- the potential issue for flying TTO (if required by the TTA/TTO concept, which is still to be confirmed in Step 1) on entry points of congested areas determined in LAT-LON. If TTOs on LAT,LON points are expected to be flown in FRA, the impact on the AU's operating method (during the planning/execution phase) would need to be assessed.

The different approaches defined to assess complexity at ATSU level would need to be deeply analysed to be adapted to DRA/FRA environment.

Disclaimer: The above features are described here as part of the environmental aspect of direct routing and free routing implementation but are **out of scope of the SESAR Solutions #32 and #33** described in this document. These solutions are focused on the operational needs for Airspace Users and ATS units. Nevertheless, the assumptions related to ATFCM at Network level in direct routing and free routing environments are listed hereafter.

2.2.3.1 Assumptions relating to ATFCM in Direct Routing environment

Identifier	ASS-04.07.02-SPR-DRFM.0101
Assumption	The Local Traffic Manager will inform the Network Manager of current and planned sector configuration in Direct Routing environment

Identifier	ASS-04.07.02-SPR-DRFM.0102
Assumption	In Direct Routing environment, LTM/local-DCB actors will be able to assess Entry/Occupancy count prediction for the next 3-6 hours on all monitored TV/Flows

Identifier	ASS-04.07.02-SPR-DRFM.0103
Assumption	In Direct Routing environment, LTM/local-DCB actors will be able to create/modify monitoring flows for DCB purposes

Identifier	ASS-04.07.02-SPR-DRFM.0104
Assumption	In Direct Routing environment, DCB automated/assisted warning of potential imbalance detection to the LTM/local-DCB actors will be applicable

Identifier	ASS-04.07.02-SPR-DRFM.0105
Assumption	A rerouting option will be proposed to AUs by the Network Manager in case of a being affected by a regulation in Direct Routing environment

Identifier	ASS-04.07.02-SPR-DRFM.0106
Assumption	In Direct Routing environment, LTM/local-DCB actors will be able to declare

	a Hotspot inside their area of responsibility

Identifier	ASS-04.07.02-SPR-DRFM.0107
Assumption	In Direct Routing Airspace, LTM/local-DCB actors will be able to cancel a Hotspot inside the LTM/local DCB actor's area of responsibility using the cancellation management process

Identifier	ASS-04.07.02-SPR-DRFM.0108
Assumption	In Direct Routing environment, LTM/local-DCB actors will be able to identify the list of flights captured in a hotspot within their area of responsibility

Identifier	ASS-04.07.02-SPR-DRFM.0109
Assumption	In Direct Routing Airspace, LTM/local-DCB actors will be able to access DCB relevant flight information for flights captured in a hotspot within the LTM/DCB actor area of responsibility

Identifier	ASS-04.07.02-SPR-DRFM.0110
Assumption	In Direct Routing environment, published navigation points will be usable by LTM/local-DCB actors to define lateral STAM rerouting measures

Identifier	ASS-04.07.02-SPR-DRFM.0111
Assumption	In Direct Routing environment, LTM/local-DCB actors will be able to use the following standard STAM measures: - Flight Level Capping, - Departure Time Shift

Identifier	ASS-04.07.02-SPR-DRFM.0112
Assumption	In Direct Routing environment, LTM/local-DCB actors will assess the potential impact of STAM measures within the LTM/local-DCB actor's area of responsibility

Identifier	ASS-04.07.02-SPR-DRFM.0113
Assumption	In Direct Routing environment, the Network Manager will update the flight plan according to the required departure time modification on behalf of the concerned Airspace User implementation time where time shift based ATFCM measures are concerned

2.2.3.2 Assumptions relating to ATFCM in Free Routing environment

Identifier	ASS-04.07.02-SPR-FRFM.0102
Assumption	NOP information will contain the actual sector volumes together with hotspot identification in Free Routing Airspace

Identifier	ASS-04.07.02-SPR-FRFM.0103
Assumption	NOP information will contain the exclusion zones inside Free Routing Airspace together with their specification

Identifier	ASS-04.07.02-SPR-FRFM.0104
Assumption	NOP information will contain the latest updated information on all DCB measures – planned and actual ones in Free Routing Airspace

Identifier	ASS-04.07.02-SPR-FRFM.0101

Assumption	The Local Traffic Manager will notify Network Manager of current and planned sector configuration in Free Routing Airspace.

Identifier	ASS-04.07.02-SPR-FRFM.0102
Assumption	In Free Routing Airspace, LTM/local-DCB actors will be able to assess Entry/Occupancy counts prediction for the next 3-6 hours on all monitored TV/Flows

Identifier	ASS-04.07.02-SPR-FRFM.0103
Assumption	In Free Routing Airspace, LTM/local-DCB actors will be able to create/modify monitoring flows for DCB purposes

Identifier	ASS-04.07.02-SPR-FRFM.0104
Assumption	In Free Routing Airspace, DCB automated/assisted warning of potential imbalance detection to the LTM/local-DCB actors will be applicable

Identifier	ASS-04.07.02-SPR-FRFM.0105
Assumption	A rerouting option will be proposed to AUs by the Network Manager in case of a Flight Plan being affected by a regulation in Free Routing Airspace

Identifier	ASS-04.07.02-SPR-FRFM.0106
Assumption	In Free Routing Airspace, LTM/local-DCB actors will be able to declare a Hotspot inside their area of responsibility

Identifier	ASS-04.07.02-SPR-FRFM.0107
Assumption	In Free Routing Airspace, LTM/local-DCB actors will be able to cancel a Hotspot inside the LTM/local-DCB actor's area of responsibility using the cancellation management process

Identifier	ASS-04.07.02-SPR-FRFM.0108
Assumption	In Free Routing Airspace, LTM/local-DCB actors will be able to identify the list of flights captured in a hotspot within their area of responsibility

Identifier	ASS-04.07.02-SPR-FRFM.0109
Assumption	In Free Routing Airspace, LTM/local-DCB actors will be able to access DCB relevant flight information for flights captured in a hotspot within the LTM/DCB actor area of responsibility

Identifier	ASS-04.07.02-SPR-FRFM.0110
Assumption	In Free Routing Airspace, published navigation points will be usable by LTM/local-DCB actors to define lateral STAM rerouting measures

Identifier	ASS-04.07.02-SPR-FRFM.0111
Assumption	In Free Routing Airspace, LTM/local-DCB actors will be able to use the following standard STAM measures: - Flight Level Capping, - Departure Time Shift

Identifier	ASS-04.07.02-SPR-FRFM.0112
Assumption	In Free Routing Airspace, LTM/local-DCB actors will be able to assess the potential impact of STAM measures within the LTM/local-DCB actor's area of responsibility

Identifier	ASS-04.07.02-SPR-FRFM.0113
Assumption	In Free Routing Airspace, the Network Manager will update the flight plan according to the required departure time modification on behalf of the concerned Airspace User implementation time where time shift based

	ATFCM measures are concerned

2.3 Services related to ATS Operations

In the absence of any modelling of the Services related to Free Route in EATMA V7 [19], the following table describes the processes related to En-Route ATS Operations which are of interest for Free Route operations.

Process Id and Title	Description	Relationship with Free Route
Enhanced ATFCM processes		
Perform Extended ATC Planning	This process describes the main activities related to the management of the traffic complexity in En-route ACCs: complexity assessment, determination of de-complexing measures and their application and monitoring. The applied measures can consist on the deployment of pre-determined ATC Sector Configurations and the modification of individual trajectories or traffic flows.	Also applicable to Free Route environments for complexity management inside DRA/FRA
Ground Based Separation Provision in En-Route		
Provide Planning Separation Assurance	Separation assurance at planning level is a continuous process triggered on a cyclic basis in order to detect and solve potential interactions between (pairs of) aircraft and between aircraft and restricted airspace that are within his/her area of interest, at every step of the coordination process (e.g. receipt of an offer, selection of a suitable sector exit level etc.). According to the ATSU/ ATC team configuration, planning separation can be provided by the EAP, the MSP and/or the PC. Conflict resolution in planning terms may involve the identification of alternative co-ordination conditions (level, route, profile etc.) at either the entry and/or exit boundaries of the sector. Alternatively, it may involve an iRBT revision by either allocating a 2D RNP route or defining a new portion of the iRBT.	Also applicable to Free Route environments including coordination of flights outside named COP in DRA/FRA Coordination procedures will require being adapted to DR and FR operations including cross-border aspects. Moreover, the coordination procedures between adjacent ATSUs will no longer be based on published coordination points; this might also require some FDPSs to be adapted. Trajectory-based Medium-Term Conflict Detection (MTCD) will support the controller team in providing the ATC service. This support tool might not be needed in low complexity environments; on the other hand they might be highly required in order to guaranty a certain level of capacity in more complex areas.
Provide Tactical Separation Assurance	This process describes how the controller (mostly the Executive, and sometimes the Planning) detects and solves potential profile problems between (pairs of) aircraft and between aircraft and restricted airspace that are within his/her area of responsibility. It	Also applicable to Free Route environments including tactical actions/iRBT revisions inside DRA/FRA In FRA (depending on the structure and distribution of the user-defined

Process Id and Title	Description	Relationship with Free Route
	addresses remaining potential interactions that have been highlighted by the planning control. Conflict resolution in tactical terms may involve the identification of different solutions, e.g. by modifying the trajectory laterally, vertically or in terms of speed adjustments. In the envisaged operational environment priority should be given to solutions that impose a minimum deviation from the iRBT.	segments within the airspace), and possibly in DRA (depending on the density of the Direct Routing network), special attention should be paid to the separation responsibility for those conflicts occurring close to a sector boundary or at the sector boundary. The inter-ATSU coordination procedures and associated working method might require to be amended.
Ensure Trajectory Adherence	This process is run on an iterative basis and consists in monitoring the traffic situation and detecting when aircraft deviate from the predicted trajectory. This may lead to safety critical situations that must be detected as early as possible so that the controller can react quickly and resolve them. Both the planning and the tactical controllers can be involved in the process.	Also applicable to Free Route environments including for flights outside ATS routes inside DRA/FRA MONA is highly required in FRA, where it is more difficult for the ATCO to monitor flights adherence to their trajectory, Enhanced Monitoring Aids (MONA) will support the controller team in providing the ATC service.
Ground Based and Airborne Safety nets		
Perform airspace infringement management (APW) **(not defined in EATMA V7)**	The airspace infringement management process relates to the management by controllers of unauthorised airspace penetration by aircraft into segregated, prohibited or danger areas, assisted by Area Proximity Warning (APW). (Source P4.8.1 Step 1 OSED)	Also applicable to Free Route environments
Perform Short-Term Conflict Management (STCA)	The short-term conflict management process relates to the management of mid-air collision hazards (involving at least one controlled flights) by air traffic controllers assisted by Short Term Conflict Alert (STCA).	Also applicable to Free Route environments
Manage Imminent Mid-Air Collision (ACAS)	The imminent mid-air collision management process relates to the management of mid-air collision hazards (involving at least one ACAS equipped aircraft) by flight crews and ACAS RAs.	Also applicable to Free Route environments

Table 4: Processes related En-route ATS Operations in Free Route

Within Free Route airspace, the unstructured traffic flows may be sometimes difficult to manage by ATCOs. Extended ATC Planning at ACC level might help maintaining traffic complexity at an acceptable level for ATCOs and hence Sector Team workload at optimum level (through the provision of de-complexification measures (at local level) whenever early resolution brings operational benefits). The benefits of Extended ATC planning in FRA nevertheless require to be further evaluated

particularly in environments of high complexity (and this feature is **out of scope of the SESAR Solutions #32 and #33** described in this SPR document).

Regarding separation provision, the use of PBN for separation purposes in Free Route airspace is **out of scope of the SESAR Solutions #32 and #33**. Considering aircraft current capabilities, the PBN performance in original direct or user-defined segment (not based on an ATS route segment) or in offset to this segment is not known. This limitation might be overtaken by the publication of an air navigation specification requirement for the Free Route airspace, and the determination of the spacing minima (between the original and parallel segments) applicable by ATCOs when using Parallel Offsets to provide separation in the airspace. However, this concept element has not been V3 validated (and is therefore **not part of the SESAR Solutions #32 and #33** described in this SPR document). Hence there is no requirement in this document for a specific navigation performance on direct segments or user-defined segments in Free Route airspace or for the airspace itself.

Besides, procedures for how to clear back to an initially planned trajectory defined by LAT,LON points would need to be further elaborated and validated to find a harmonised solution. The introduction of CPDLC might offer some solutions for this issue, as it will be possible to uplink LAT,LON clearances to a proportion of equipped aircraft, and there might also be a need for new phraseology/methodology to solve this issue. It should however be noted the mainstream of the fleet is not expected to be suitably equipped to cope with uplinked LAT,LON clearances at the Step 1 timeframe. Other solutions will therefore need to be elaborated (to cope at least with non-equipped aircraft) if use of LAT,LON clearances is envisaged in FRA. This feature is **out of scope of the SESAR Solution #33** described in this SPR.

No change is anticipated to be required for the En-Route Ground-based Safety Nets, i.e. STCA and APW, and the Airborne Safety Net, i.e. ACAS, to continue to play a major role in the safety of En-Route operations.

2.4 Description of Operational Environment

2.4.1 Airspace Characteristics

2.4.1.1 General

The concept of free route operations is applicable to any area where free route airspace is implemented within the European airspace network. This could either be the concept of direct routing operations in Direct Routing environment or Airspace (DRA) or the concept of free routing operations in Free Routing Airspace (FRA).

To maximise the efficiency of Free Route operations, Direct Routing and Free Routing Airspace over Europe need to be defined at a large geographical scale across FIRs/FABs. The applicability of Direct Routing and Free Routing operations in Europe at the Step 1 horizon is likely to depend on the complexity of the airspace and the demand. In the transition period before full FRA implementation in Europe, Direct Routing could be applied in high complexity environments, whereas implementation of Free Routing Airspace could be first introduced in low and medium complexity environments.

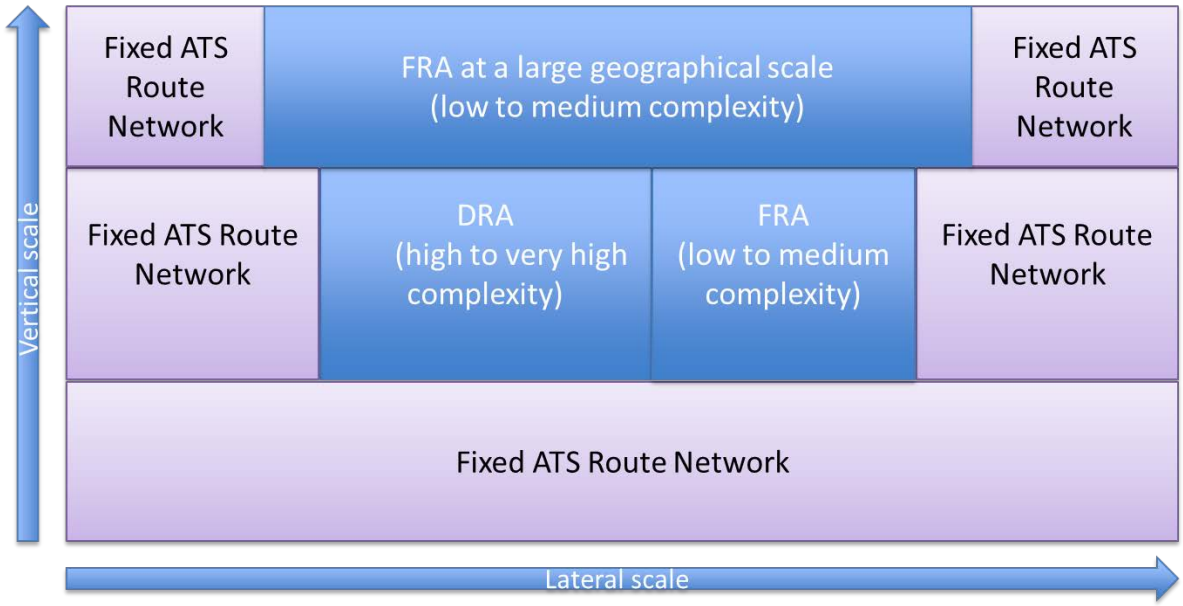

Figure 4: Example of Free Route Airspace structure

The Performance Plan for the European ATM Master Plan Edition 2015 [20] identifies Performance Needs of the various ATM Operating Environments. These Environments are defined according to complexity and traffic volume. For ACCs the traffic complexity score for 2013 of the EUROCONTROL Performance Review Report [13] is used to define three categories (of En-route complexity) as follows:

- En-Route High Complexity: traffic complexity score higher than 6
- En-Route Medium Complexity: traffic complexity score higher than 2 but lower than 6
- En-Route Low Complexity: traffic complexity score Lower than 2

This complexity indicator is a composite measure which combines a measure of traffic density (concentration of traffic in space and time) with structural complexity (structure of traffic flows). It is therefore representative of:

- The level (and characteristics) of the traffic demand in the airspace (and the need for Enhanced DCB including Complexity Management at regional/sub-regional/local level and/or Enhanced Conflict Management and Automation at local level).

Other environmental factor anticipated affecting the complexity of En-route airspace (and which needs to be taken into account when envisaging deploying Free Route operations) include:

- The level of interference between civil / military activity in the airspace (and need for AFUA to balance traffic / airspace demand by civil / military AUs).

Despite the fact that individual implementations of Free Route airspace exist today, greatest benefits can only be realised after harmonisation. It is therefore required to have the same basic rules concerning publication, design principles and constraints, structural elements and hence flight planning requirements. Within these basic rules and structures each ANSP or FAB has some leeway with regards to its own implementation.

2.4.1.2 Common airspace characteristics

The general assumptions regarding airspace characteristics eligible for Free Route operations are summarised in the table below:

Characteristic	Free Route Airspace Characteristics in Step 1
Airspace Classification	Free Route operations airspace will, in principle be classified as Class C airspace, with certain agreed exemptions (ref. European Route Network Improvement Plan (ERNIP), Part 1 [10])
Flight Level Orientation	The Flight Level Orientation Scheme (FLOS) applicable within Free Route operations airspace shall be promulgated through the relevant national AIS publications. (This does not constitute a change to the current system of 2 FLOS in Europe).
Airspace Organisation	Direct Routing and Free Routing Airspace forms an integral part of the overall European ATM network, interfacing vertically or laterally with adjoining fixed route environment. Airspace reservations will remain, and as all airspace users will have equal access to Free Route operations airspace, harmonised application of the FUA Concept and Civil/Military Coordination are taken into account in order to ensure harmonised procedures and service provision for the benefit of all the airspace users. Some constraints for AUs will still remain in FRA. The most adequate way to publish constraints in FRA is via the use of restrictions on airspace volumes. There will still be a need to organize certain traffic flows around high density airports and to exclude some flows from some sectors. Constraints are needed to manage capacity, both from NM and ANSPs perspective. The restrictions have to be kept at a minimum level and be published to AUs. The RAD has to be constructed and presented to AUs in a harmonized way. At NM level, all the functionalities exist to manage these constraints (RAD Appendix 7, AUP/UUP).
Publication and maintenance of ATS Route Network	There is no over-arching requirement for a European contingency fixed ATS route network in FRA. The conclusion has been made just to maintain published waypoints (5LNC). It will be up to each ANSP to decide if the fixed route network shall be maintained or not, as the ATS route network is no longer required. Waypoints (5LNC) and possible fixed route network shall be published in AIS publications.

Characteristic	Free Route Airspace Characteristics in Step 1
Sectorisation	The present sectorisation scheme may need to be restructured to accommodate traffic flows within FRA. The traffic will potentially be spread over a wider area of the sector, instead of structured flows of traffic along the route network. Sector design will need to respond to this change and may need to be more flexible as traffic demand varies. If required, mixed operations (ARN/Direct Routing/FRA) should be taken into account in sector design phase. Sector design criteria should, at least, take into account: • The principle traffic flows and orientation • Minimizing short transits through sectors • Minimizing sector and ACC re-entry • Positions of airspace reservations • Coherency with adjoining fixed route sectors and link routes to SIDs and STARs • Civil / military coordination aspects. Sectors shall be aligned as far as possible so that the number of flights with short transit times is reduced to a minimum. If this is not feasible an ANSP may request such traffic to be exempted from Network Manager traffic demand counts. More flexibility in defining a larger number of elementary sectors/airspace volumes and sector configurations might need to be explored. Operationally designed cross-border sectors may be more beneficial were Free Routing operations are implemented in adjacent areas. Local FMPs will have to take a more proactive role in the selection of optimum sector configurations corresponding to traffic demand. Active sector configurations shall be dynamically communicated to the Network Manager and CIV/MIL ATC units.
Letters of Agreement and Coordination Procedures	Letters of Agreement shall be adapted to reflect the specificities of Free Route operations in regard to transfer points, flexible changes in sectorisation, links with the fixed route network, high fluctuations in traffic flows, possibility to leave/enter the airspace at random points, etc. Appropriate mentioning of ATS delegation in areas involving Free Route operations shall be fully considered. The automatic exchange of flight data between ACCs will need to consider the possibility of transfer at random points using dynamic COPs. This would be facilitated by exchange of FPL field 15 (via OLDI) or through the use of G-G IOP. Transfer procedures and restrictions currently stipulated in the existing Letters of Agreement may no longer be applicable in airspace allowing for Free Route operations. Appropriate procedures shall be defined to reflect these new provisions.
ATS delegation	In areas where operational boundaries do not coincide with FIR/UIR boundaries, and delegation of ATS is effective, if one ATC unit has implemented Free Route Airspace but the adjacent one has not, the operational boundaries of Free Route Airspace shall be published in the national AIS publications of both States. The Letters of Agreement between the concerned ATS units shall be amended accordingly to reflect any changes to the applicable procedures in the airspace where ATS is delegated.

Table 5: Free Route Airspace characteristics in Step 1

2.4.1.3 Direct Routing Network and Airspace (DRA)

Airspace Organisation

Options for Publication for Direct Routing Airspace

There is no over-arching requirement to publish in AIP a Direct Routing Airspace with its defined lateral and vertical limits, except in case of removal of the fixed ATS route network inside the Direct Routing Airspace.

Vertical Limits of Direct Routing Airspace and Their Publication

Whenever a Direct Routing Airspace is to be published, its vertical limits shall be published in the relevant national AIS Publications.

The upper and lower vertical limits shall be coordinated at European network level to ensure smooth connectivity with the underlying fixed ATS route network, especially when the latter has been removed inside the Direct Routing Airspace.

Horizontal Limits of Direct Routing Airspace and Their Publication

Whenever a Direct Routing Airspace is to be published, its horizontal limits shall be published in the relevant national AIS Publications. In order to gain full benefits from its applicability, the horizontal limits should be based on operational requirements boundaries, and is expected to be cross-border (i.e. across national FIR/UIR boundaries or inter-ATS Units).

En-Route Direct Routing Network

Direct Routing Publication

A Direct Routing, by definition, is a succession of Direct Segments and ATS route segments.

It is not expected that Direct Routings will be published as such, as all combinations of elementary Direct Segments should be available unless otherwise indicated in the RAD. The Direct Segments shall be published within the RAD Appendix 4, as DCTs as it is done today, with their segment limits (from/to points), their conditions of use (time restriction, area restriction, flows restriction).

It is recommended for Airspace Users, to use a mapping Tool of Direct Segments to support their flight planning through Direct Routings.

The conditions of use of Direct Segments shall be kept as simple as possible in order to make RAD constraints manageable by Airspace Users.

Maintenance of a Fixed ATS Route Network within Direct Routing Airspace

As far as possible the fixed ATS route network will be maintained inside Direct Routing Airspace so as to provide more flight planning options to all airspace users. Indeed, mixed use of Direct Segments and fixed ATS route segments will provide more flexibility to airspace users.

Wherever a Direct Routing Airspace is published (with or without a fixed ATS route network), entry and exit points of the Direct Routing Airspace, as well as any intermediate points of the Direct Routing Network, shall be published in AIS publications.

Connection between Direct Routing *Network and the underlying/Adjacent Fixed ATS Route Network*

The interconnectivity between Direct Routing Network and the underlying/adjacent fixed ATS route network can be ensured by the use of published points interfacing the Direct Segments of the Direct Routing Network to the fixed ATS route network.

Direct Segments defined within the Direct Routing Airspace can be used as per their published levels, which in some cases can be below DRA vertical limit in order to allow for descent/climb profiles or to allow connectivity where airways do not exist.

Wherever a Direct Routing Airspace is published (with or without a fixed ATS route network), its entry and exit points shall be connected to the underlying and to the adjacent fixed ATS Route Network.

Maximising Efficiency of Direct Routing Network

Offering Maximum Flexibility in Flight Planning to AUs

In order to facilitate flight planning while allowing aircraft operators' flight planning flexibility, Long Range Direct Routings - i.e. large geographical scale cross-border Direct Routings structured along the main traffic flows and accommodating the in-demand traffic - will be used to optimize the En-Route Direct Routing Network.

The efficiency of a Direct Routing Network will be maximized by a good access to Long Range Direct Routings which can be provided by shorter connecting Direct Segments and by the use of Intermediate Points allowing for joining in or leaving the long Range Direct Routings for any reason and/or at any time. The promulgation of these Intermediate Points shall be made through relevant national AIS publications with a clear indication of the nature of these points (intermediate points).

Easing Safe Management of Direct Routings by ATC

The mix of Direct Routings and fixed ATS Routes can be sometimes difficult to manage at ATC level. Indeed, conflict in border of the sector is an important source of complexity that might be difficult to manage in execution phase.

In order to ease the safe management of Direct Routings by ATS, Direct Segments leading to conflicts close to sector boundaries might be limited.

Optimal Design Options for Direct Routing Network

In summary, optimal design options for the Direct Routing Network will be:

1. Some cross-border Direct Routings defined along major traffic flows at large geographical scale (referred to as **Long Range Direct Routings** in this OSED) which may be joined/left at various published intermediate points;

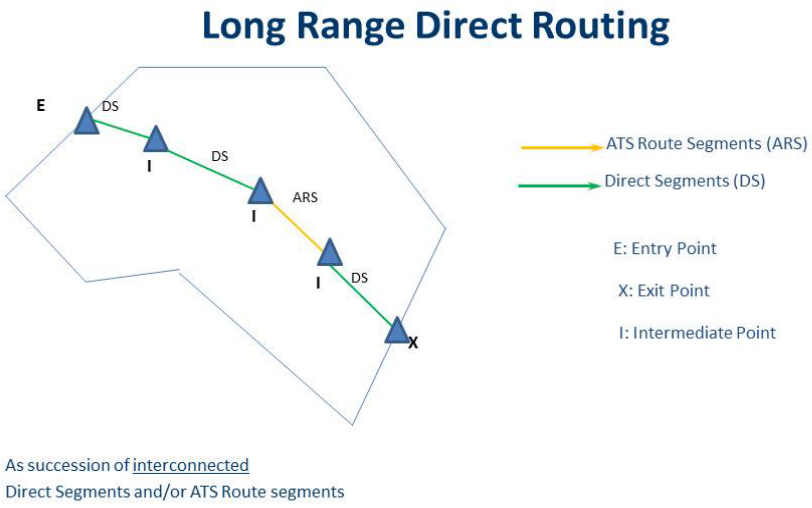

Figure 5: Examples of Long Range Direct Routings

2. Many shorter Direct Routings – constituted by a single of few Direct Segments - used to:
    a. Connect Long Range Direct Routings from/to a route of the fixed ATS Route Network (for secondary flows and/or arrival/departure flows);
    b. Provide shortcuts;
    c. Avoid ARES;
    d. Etc.

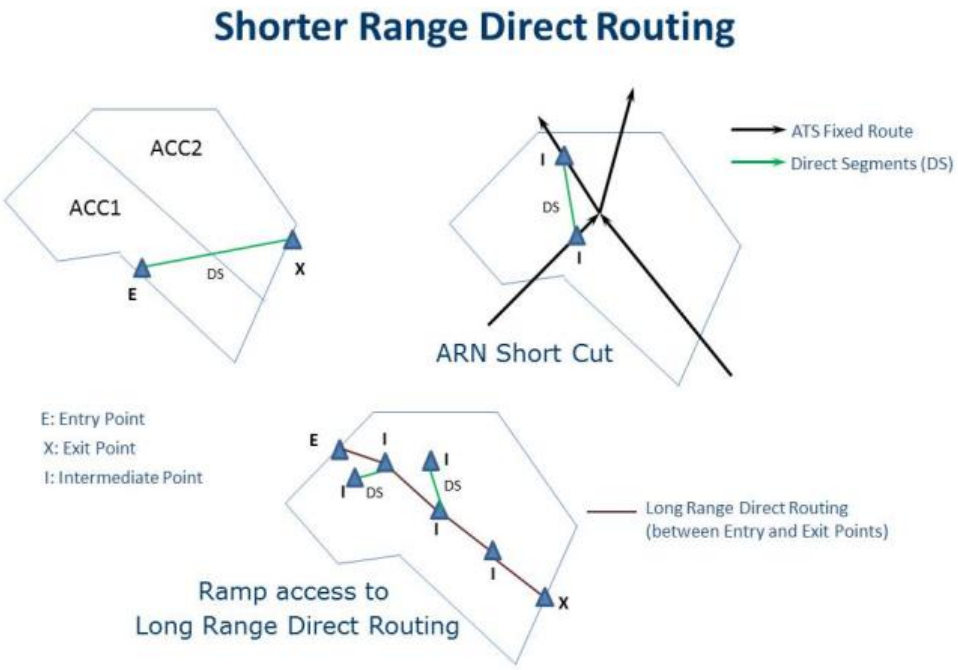

Figure 6: Examples of Short Range Direct Routings

3. In any case, with cross-border Direct Segments (beyond national FIR boundaries /ATSU areas of responsibilities);
4. Direct segments are not necessarily designed with strategic separation.

2.4.1.4 Free Routing Airspace (FRA)

Limited Applicability of Free Routing Airspace Operations

Time Limited

Even though the goal is to implement Free Routing Airspace operations on a permanent basis to satisfy the PCP regulation, a limited implementation during defined periods of time could facilitate early implementation. Procedures for transitioning between free routing and fixed route operations shall be set. The change should not be made dynamically but in a strategic way (e.g. night/day). The dimensions of FRA should be described and published in the relevant national AIS Publications together with the associated times of availability.

Structurally Limited

Depending on requirements some ANSPs may decide to implement Free Routing Airspace operations on a structurally limited basis during early implementation, for example by restricting the available entry/exit points for certain traffic flows, which could increase predictability and reduce the number of “unpredictable” conflicts.

Airspace Organisation

Publication of FRA

The publication of FRA shall be made in a harmonized way based on ICAO and ERNIP guidelines, in each national AIP. Simplification shall be made as far as practical to support user friendliness. AUs shall have access to any relevant information regarding the FRA (maps, common rules etc.) by using the AIP from any of the participating states.

Vertical Limits of Free Routing Airspace

The lower limit of FRA shall not impact adjacent areas where FRA is not yet implemented or where only limited Free Routing operations are in place. A common minimum Divisional Flight Level (DFL) at FL305 is foreseen to satisfy the PCP regulation (a stepped approach might be needed). Existing implementations of FRA have demonstrated that it is acceptable to have different DFLs within a given FRA e.g. depending on national FIRs (NEFRA).

Nevertheless, with goal being a harmonised airspace structure across the European network, the following recommendations are made:

- The lower vertical limit shall be coordinated at European network level to ensure interconnectivity with adjoining airspace and this could vary in different areas or at different times within a particular Free Routing Airspace.
- The minimum level should be the lowest feasible, taking into account the complexity of the airspace and the demand.

Horizontal limit of Free Routing Airspace

Today there are many FRA initiatives throughout Europe. Merging of those initiatives into bigger FRAs is foreseen to facilitate operations for AU, as rules and regulations can be harmonised in a wider area. There may still be a requirement for different FABs/ ANSPs to adapt local implementations but this will be done within the framework of common rules. Few individual FRAs as possible within Europe seems to be the most beneficial solution for AUs. As there will most likely be too much variety in traffic density/complexity in the European airspace, additional R&D work is nevertheless needed to generalise the Free Routing SESAR 1 outcomes at a Europe-wide scale.

Vertical connection from ARN/DRA to FRA

The transition according to FPL from ARN/DRA to FRA will be made after a specific waypoint, filed in the FPL, after which the FRA trajectory commences. If during the execution of the trajectory the DFL into FRA is crossed before the waypoint filed for transition the trajectory can still be executed as filed.

If however during execution the DFL into FRA is reached after the filed waypoint this would result in a situation where a FRA trajectory is filed whilst the aircraft is still in ARN airspace. Whilst such a situation should only occur as a non-nominal case, it can only be resolved tactically. The higher the lower limit of FRA is, the greater the risk for such non nominal situation to occur.

With some existing implementations, depending on the environment, the possibility to start FR segments when still in ARN airspace is allowed if the final requested FL is inside FRA (e.g. NEFRA).

Vertical connection from FRA to ARN

The transition according to FPL from FRA to ARN/DRA can be made at any published waypoint or between published waypoints if they are connected by a published DCT or ARN segment. If an aircraft needed to descend below FRA airspace before the filed DCT/ARN trajectory commences this would require to be solved tactically.

Horizontal connection to/from FRA and entry/exit points

Entry/exit points shall ensure interconnectivity to adjacent route network (ARN/DRA). They are mandatory for flights to/from FRA, to allow a structured transition between the two operational environments; this may not necessarily be at the FAB, FIR or ATC unit boundary.

Use of entry/exit points between two adjacent FRAs is not mandatory. The AUs will have the possibility to file cross-border DCTs between intermediate waypoints. However, boundary points might be needed for coordination facilitation, and to preserve a high ATCO situational awareness (not to be filed by AUs, but used by ANSPs). As part of the Free Routing concept re-entrance in FRA from adjacent non-FRA airspace via non published waypoints is not allowed, but to satisfy operational requirements it might be more beneficial at certain occasions. If adjacent airspace is non-FRA but re-entrance into FRA is unavoidable agreements have to be made with adjacent ATSU.

The same rules are applicable for transition between FRA and DRA as transition between FRA and ARN.

Entry/exit points and horizontal limits of Free Routing airspace shall be published in relevant national AIS publications with a clear reference to the Free Routing Airspace and to the nature of the point (entry, exit or entry/exit point).

Connecting points

A connecting point could be any published point connected to the ARN or to the published Direct Routing network. It could be the last waypoint of the SID/departure connecting ATS route or the first waypoint of the STAR/arrival connecting ATS route for departing/arriving aircraft. At the connecting point, the aircraft shall be within the vertical limit of FRA and will then have the opportunity to start Free Routing or join the ARN (depending on whether it´s entering or exiting FRA).

To organize traffic around bigger airports a certain airspace organisation or structure has to be created. A possible way to achieve this is to introduce arrival/departure connecting points linked to ATS routes to/from FRA or extended SID/STARs. The connecting point (with constraints) as well as connecting ATS route/SID/STAR shall be published in the RAD. Even if this is a constraint for AUs it´s considered necessary to sequence and organize traffic around bigger airports.

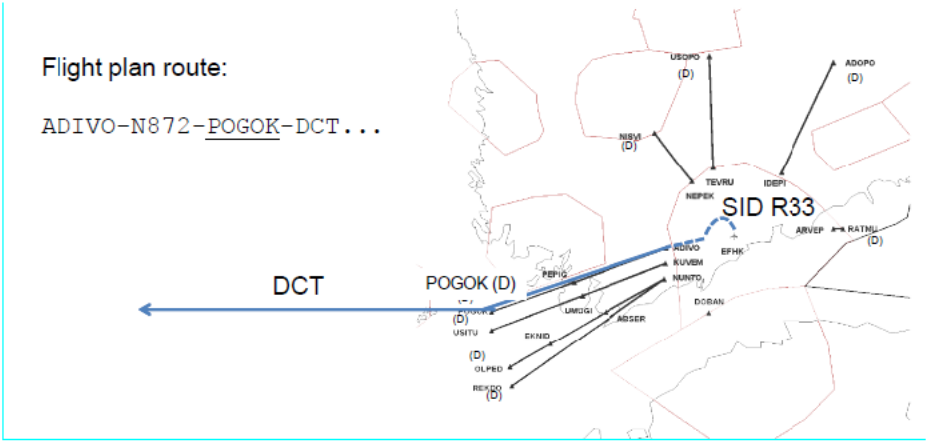

Figure 7: Example of FRA Connecting Point for Departing traffic (source NEFRA)

The length of the connecting ATS routes can be adapted according to the needs by the ATSU. E.g. a longer route will give the A/C more time to climb/descend, hence ending/starting the procedure at a higher FL. In some areas there might be a possibility for AUs to start Free Routing at a low level, while in others at a high level. Nevertheless, it will ensure that a majority of flights will be at or above a desired FL before starting/ending Free Routing operations. At smaller airports there is also a possibility to publish a connecting point at the TMA boundary both for arriving and departing traffic (with any applicable constraint). This later case is only applicable if the Free Routing operations can start at a lower FL.

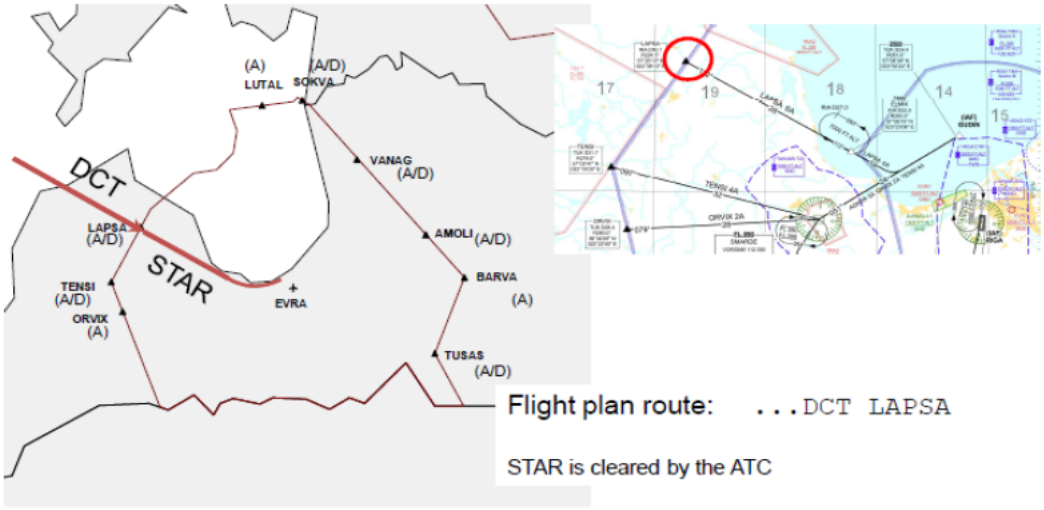

Figure 8: Example of FRA Connecting Point for Arriving traffic (source NEFRA)

2.4.2 Traffic Characteristics

2.4.2.1 General

The general assumptions regarding traffic characteristics eligible for Direct Routing or Free Routing Airspace are summarised in the table below:

Type of Assumption	AOM-0500 Direct routing for cross ACC borders and in high complexity environments	AOM-0501 Free routing within low to medium complexity environments
Traffic Characteristics:	Step 1 Full Operational Capacity (year 2019)	Step 1 Full Operational Capacity (year 2022)
• Traffic Level for En-Route ACC	Very High Capacity: 300 movements per busy hour High Capacity: between 200 and 300 movements per busy hour	Medium Capacity: between 50 and 200 movements per busy hour Low Capacity: 50 movements per busy hour
• Traffic Mix	Mix of business / mission flights (essentially IFR flights) Accommodation of a variety of different a/c capabilities is likely to be required in DRA / FRA in the Step 1 horizon	
• Traffic Patterns	Overflights, climbing and descending flights above a certain vertical limit	Primarily overflights, limited number of flights climbing and descending, above a certain vertical limit

Table 6: Free Route Traffic characteristics in Step 1

According to the EUROCONTROL STATFOR Medium term forecast [14], the traffic forecast is for 11.4 million IFR movements (±1 million) in Europe in 2021, 19% more than in 2014 (The average expected European growth rate over the 7 years (2014-2021) is for 2.5% per year.

2.4.2.2 Traffic Demand

In this forecast all IFR flights, including military and general aviation flights operating under GAT IFR rules, are included.

ESRA08		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	AAGR 2021/ 2014
IFR Flight Movements (Thousands)	H	.	.	.	.	9,834	10,228	10,675	11,089	11,487	11,957	12,332	3.6%
	B	9,784	9,548	9,447	9,604	9,750	10,039	10,310	10,588	10,852	11,166	11,397	2.5%
	L	.	.	.	.	9,638	9,803	9,876	10,001	10,124	10,263	10,343	1.1%
Annual Growth (compared to previous year)	H	.	.	.	.	2.4%	4.0%	4.4%	3.9%	3.6%	4.1%	3.1%	3.6%
	B	3.1%	-2.4%	-1.1%	1.7%	1.5%	3.0%	2.7%	2.7%	2.5%	2.9%	2.1%	2.5%
	L	.	.	.	.	0.4%	1.7%	0.8%	1.3%	1.2%	1.4%	0.8%	1.1%

Table 7: IFR movements Medium Term Forecast (ESRA08[5])

The traffic demand related to Free Route will depend on the lateral and vertical limits of the airspace allowing for Direct Routing / Free Routing operations, as well as the percentage of the traffic able to plan/re-plan using direct routings / user-defined segments, particularly during the transition phase before full implementation of the concept.

[5] *The EUROCONTROL Statistical Reference Area (ESRA) is a large, fixed region covering most of Europe.*

2.4.2.3 Aircraft capabilities

A variety of different aircraft capabilities is likely to be encountered in Europe at the time horizon of the Free Route Solutions deployment (with a mix of baseline and Step 1 capabilities available on-board aircraft).

The baseline aircraft CNS capabilities related to the SESAR Solutions #32 and #33 are summarised in the table below.

Aircraft Capabilities in Free Route environment	
COM	• Technical capability, both in pre-departure and during execution, to receive by ACARS[6] from FOC and easily load in airborne Navigation functions 3D trajectories based either on published routes (SIDs, Airways, STARs) or User Preferred Routes with non-published waypoints[7] • Progressive[8] capabilities for Air / ground data link exchange of CPDLC messages allowing to easily load in Navigation systems clearance / closed loop instruction for "Proceed DIR TO", "Proceed New route", etc.
NAV	• Basic navigation capabilities to manually modify, delete, add route segments of waypoints in the FMS (Flight Management System), including a Lat/Lon point (➔ procedurally limited to integer LAT/LON in continental airspace).
SUR	• ACAS Resolution Advisory transmitted to the ground station via e.g. Mode S Transponder and ADS-B-Out as per standards DO-260A (current), then -260B (future).

Table 8: Aircraft Capabilities in Free Route environment

[6] *A large majority of mainlines (A/C & FOC) are and should be ACARS capable.*

[7] *The conditions for using non-published fixed waypoints (ex. Lat/Lons) in a safe and efficient way by the crew are still to be accurately identified, since the risk is that automatic naming of such fixes are not intuitive enough in particular when some of the Lat/lons are spaced by few tenths of NMs.*
As an illustration, the ED228 says (Flight Management System (FMS) Load Capability) :
"The aircraft data link system will provide the flight crew with the capability to load CPDLC uplink messages into the Flight Management System (FMS) to avoid hazards associated with human entry errors and/or increased workload. The following clearance messages are prone to these hazards:
• A clearance that will require the creation, in the resulting flight plan, of more than one waypoint unless the route is described by a procedure name that can be loaded from the navigation database,• A clearance that will require the creation, in the resulting flight plan, of one waypoint specified by place-bearing-distance or latitude/longitude with a resolution smaller than whole degrees.

[8] *Initial capabilities expected around 2018. It's to be noted that for part of the A/C, this loading capability for revisions to e.g. tactically conflict solving would use the unique Secondary Flight Plan of the FMS, in conflict with many others, more strategic uses (pending the airline policy). Depending on the operational impact for AUs, and also due to the fact that many aircraft DO NOT have a Secondary Flight Plan, it might be therefore necessary to perform additional developments in the FMS if CPDLC requests such as "Proceed New Route" was necessary in the medium-long term.*

2.4.3 ATS Characteristics

2.4.3.1 Separation minima

No change in En-Route separation minima is needed in relation to Free Route operations.

Separation minima between aircraft are expected to continue to be based on guidance, regulations, and factors used in today's environment (ICAO Doc 4444 Procedures for Air Traffic Management, especially Chapter 5):

- Vertical separation: FL< 410 → 1,000ft separation (RVSM);
- Horizontal separation: En Route Radar separation: 5NM

2.4.3.2 ATS capabilities

Free Route operations will impact the current working methods of the ATC operators, so it requires appropriate support tools to maintain sector capacity without a detrimental effect on safety. A variety of controller support tools is likely to be encountered in Europe at the time horizon of the Free Route Solutions deployment (with a mix of baseline and Step 1 capabilities).

Building on the EUROCONTROL First Air Traffic Control (ATC) Support Tools Implementation program (FASTI), the following ATC support tools are considered as validated and implemented:

- **Conflict Detection and Resolution (CD/R) Tools** such as MTCD (Medium-Term Conflict Detection), TCT (Tactical Controller Tool), What If tools, etc. The **Conflict Detection Tools (CDT)** provide automated assistance to the Planning Controllers, as well as Tactical Controllers. They can be used at a strategic or a tactical level. In Step 1, the What If, and the filtering tools provide assistance in the manual resolution of conflicts, by giving the controller pertinent information for developing an efficient resolution strategy.
- **MONitoring Aids (MONA)**. The MONA help controllers to reduce the workload associated with traffic monitoring tasks by providing warnings if aircraft deviate from a clearance or plan and reminders of instructions to be issued and providing conformance monitoring triggering trajectory re-calculation essential for the CDT.
- **System supported co-ordination (SYSCO)**. The concept of SYSCO is the provision of system support capability and the development of procedures to automatically electronically co-ordinate and transfer flights in sectors of an ATS unit or between adjacent ATS units, based on a shared set of flight data. In Step 1, deployment and usage of *screen-to-screen and silent coordination* tools will increase and will include inter-ATSU coordination capabilities (Flight Object support).

In Step 1, the accuracy and efficiency of the controller support tools will be improved (e.g. trajectory prediction). Controller support tools will have to be trajectory-based and take into account any new separation modes. They will also have to evolve to integrate the Free Route environment.

The baseline and new ATS capabilities supporting the SESAR Solutions #32 and #33 are summarised in the following table.

ATS Capabilities in Free Route environment	
Use of IOP for Flight Data Processing **(Optional)**	Ground-ground interoperability (ATC-ATC and ATC-ATFCM) will be in development during the Step 1 period and consequently the Step 1 iRBT/iRMT and Trajectory Management services may be rudimentary, particularly in the areas of interoperability and execution phase. In step 1, system capabilities ideally enable a full ATC-ATC and a limited ATC-ATFCM interoperability. This is made possible either by a full implementation of the Flight Object (Cf. EUROCAE document ED-133 "Flight Object Interoperability Specification" [9]), or by other methods of information exchange supporting the same flight data set as that for the Flight Object. The use of the Flight Object as an information exchange mechanism is not mandatory for Step 1, i.e. other methods can be used. However, support for the flight data set related to Initial Reference Business / Mission Trajectory (iRBT/iRMT) is needed. Initial Trajectory based operations require enhanced FDP functionalities allowing processing full 4D flight plans (including flight plans based on Free Routing concept), capable of interfacing with the 4D Common Flight Object (where implemented), allowing to manage all aspects of i4D trajectories and integrating enhanced Trajectory Prediction functionalities. Inter-ATSU coordination in Direct Routing / Free Routing environment will benefit from these functionalities when available, yet the use of IOP for Flight Data Processing is not considered as necessary for the SESAR Solutions #32 and #33.
Conflict Detection / Resolution Tools for PC/TC	To be able to handle traffic in a safe and efficient manner in high complexity environment of DRA and FRA, the Planning Controller (PC) and Tactical Controller (TC) will need a tool set to detect and solve conflicts. This could consist of (or equivalent): • (Baseline) 2/3/4D graphical trajectory presentation • (baseline or new when available) MTCD, and possibly TCT (Optional), to detect conflict between aircraft, as well as between aircraft and restricted airspace • MONA (monitoring aids) • (Baseline) SEP-tool, to visualize the minimal horizontal distance between two selected aircraft • What if and/or What-else tools (Optional) In Direct Routing / Free Routing environment, because of possible long range route segments, the Conflicts Detection algorithms will have to consider long segments as portions of Great Circles. Also, not all Detection/Resolution algorithms are adapted to FRA: the rule-based algorithms that take advantage of today's ARN route scheme cannot be adapted to a user-defined traffic. Only geometric algorithms can fit with an un-structured traffic. It may also happen that some current CD/R tools for the PC in a Fixed Routes environment are limited to detect conflicting entry/exit sequences, leaving the TC with the crossing conflicts. In Free Route operations across ACC/FIR borders where conflicts may occur arbitrarily close to the sector boundaries, the CD/R Tools for the PC will have to take into account all kind of conflicts and not only sequencing issues.

ATS Capabilities in Free Route environment	
	Trajectory-based MTCD and MONA are considered as necessary for the SESAR Solutions #32 and #33 when operated in high and medium complexity environments. Other enhancement of existing tools or new advanced tools (like TCT, What-if and What-else tools) will provide useful assistance to controllers in Free Route environment. Nevertheless, they are not considered as necessary for the SESAR Solutions #32 and #33.
Ground-based Safety nets **(Baseline)**	Ground-based safety nets will be of prime importance in Free Routing Airspace and in complex Direct Routing Airspace as the last ATC barriers against collision / airspace infringement hazards. • Short-Term Conflict Alert (STCA) is a ground-based safety net intended to assist the controller in preventing collision between aircraft by generating, in a timely manner, an alert of a potential or actual infringement of separation minima. STCA parameters setting might require being adapted in order to better fit this purpose in Free Route environment. • Area Proximity Warning (APW) is a ground-based safety net intended to warn the controller about unauthorised penetration of an airspace volume by generating, in a timely manner, an alert of a potential or actual infringement of the required spacing to that airspace volume, which require attention/action.

Table 9: ATS Capabilities in Free Route environment

3 Requirements

This section describes the safety and performance requirements related to the SESAR Solutions #32 and #33. The SPR requirements show traceability to the operational requirements (applicable to Processes and Services (P&S)) as described in the OSED.

Requirements have been written using SESAR Requirements and V&V Guidelines [2].

Their description uses the layout described in SESAR Templates and Toolbox User Manual [3].

Note to the reader: The safety and performance requirements listed hereafter constitute a comprehensive list of requirements covering all aspects and tools supporting the deployment of the SESAR Solutions #32 and #33 (some of which could be handled by already existing procedures and tools). These requirements (that use the operative verb "**shall**") are considered as "Essential" requirements for the safety and performance aspects of the Solutions.

Assumptions related to Network Management operations (which are out of scope of the Solutions) are listed in section 2.2 and are also as considered "Essential" to support their safe and efficient deployment.

It has been adopted the following principles to identify the **Safety and Performance Requirements**:

- "**REQ-04.07.02-SPR-AABB.YYZZ**"
- "REQ-04.07.02-SPR-" Identifier prefix as defined in the SESAR Requirement & V&V guidelines;
- AABB: Reference Code defined as a combination of four alphanumeric characters, the two first letters (AA) representing the targeted operational environment (DR or FR) and the two last alphanumeric characters indicating the process to which the requirement relates to:
  - AA :
    - DR for Direct Routing
    - FR for Free Routing
  - BB
    - 00 for Transversal requirement
    - FP for BT/MT Flight Planning
    - FE for BT/MT Flight Execution
    - AM for Airspace Organisation and Management
    - FM for Air Traffic Flow and Capacity Management
    - PC for Planning Separation Assurance
    - TC for Tactical Separation Assurance
    - TA for Trajectory Adherence Assurance
    - SN for Ground-based Safety Nets
- XXYY: Reference number defined as a sequence of four digits, the two first digits indicating if the requirement relates to safety or performance and the two last being an increment in the numbering, i.e.
  - XX:
    - 01 for Safety functional requirement
    - 03 for Safety Integrity requirement
    - 10 for Performance requirement
  - YY: Incremented for each requirement

Important: to display all fields of the requirements, it is necessary that the reader is provided with the non-printable characters (toggle the ¶ button if necessary).

The Rationale field contains:

- Justification of the allocation or a reference to a source document Source (OSED, OSA, OPA),
- or, Explanation about the requirement formulation,
- and/or how the requirement has been amended for the need of consolidation.

The REQ Trace table contains the down-links to the Functional Blocks and Services to which the requirement is allocated or applies.

3.1 SESAR Solution #32 - Direct Routing across ACC/FIR borders and in high complexity environments

Note to the reader: The part of these requirements which relate to a Direct Routing Airspace apply under the assumption that such an airspace will be published in relation with Direct Routing options, especially wherever the fixed ATS Route Network is removed in the airspace.

The other requirements are not necessarily specific to Direct Routing environment (as they can also apply in fixed ATS Route Network environment), but they are necessary to support Direct Routing operations, particularly in high complexity environment.

3.1.1 Safety Requirements

Following sections presents the safety requirements derived for solution #33:

- Functional safety requirements derived from the success approach and the failure approach (to mitigate system-generated hazards) are listed in section 3.1.1.1,
- Integrity safety requirements derived from the failure approach (expressed in terms of maximum probability of occurrence) are listed in section 3.1.1.2.

3.1.1.1 Functional safety requirements (success case)

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0101
Requirement	The safety of Direct Routing operations shall be maintained at or above the current level
Title	Not compromise safety in Direct Routing environment
Status	<Validated>
Rationale	No improvement of the overall En Route safety level is expected due to the implementation of Direct Routing operations. Many potential issues have been identified during the initial phases of the Safety Assessment. Appropriate solutions and tools need to be implemented to deal with these issues and maintain the level of safety before implementation of Direct Routings (see Safety Assessment Report in section A.1.1).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DODSAF1.0020	<Full>

3.1.1.1.1 Functional safety requirements for BT/MT Flight Planning

[REQ]

Identifier	REQ-04.07.02-SPR-DRFP.0101
Requirement	Wherever a Direct Routing Airspace is published, Airspace Users shall have procedures and means in place to get information about the Direct Route Airspace volume availability
Title	Information of AU about DRA volume availability
Status	<In Progress>
Rationale	In order to be able to plan trajectories in a Direct Routing Airspace

	(published as such) the Airspace Users must obtain information about the volume availability of the DRA and process this information in a way it can be used for flight planning. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_010 of the Safety Assessment Report in section A.1.1. The live trials (WE-FREE, FREE Solutions) that demonstrated the concept of Free Route through Direct Routings including across ACC/FIR borders have not been performed in a published DRA. As there is no overarching requirement to publish a DRA, it is recommended to complete the validation of this requirement during the pre-operational phase in the local environments where a DRA is envisaged to be published.
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR11.0160	<Full>
<ALLOCATED_TO>	<Functional block>	Data Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRFP.0102
Requirement	Airspace Users shall have procedures and means in place to get information about whether ARES is active within a Direct Routing environment
Title	Information of AU about active ARES within Direct Routing Environment
Status	<Validated>
Rationale	In order to be able to plan trajectories around ARES when they are active, Airspace Users must obtain information about their activation within the Direct Routing Environment and process this information in a way it can be used for flight planning. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_011 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR11.0165	<Full>
<ALLOCATED_TO>	<Functional block>	Data Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRFP.0103
Requirement	Airspace Users shall have procedures and means in place to get information about existing direct segments and associated conditions of use
Title	Information of AU about available direct segments in direct routing environment
Status	<Validated>
Rationale	In order to be able to plan trajectories in direct routing environment, airspace user must be informed of the segments that they are allowed to use and of the possible condition of use associated to these segments.

	Condition of use are defined in RAD Appendix 4 and Appendix 7 (for direct segments crossing ARES) This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_011 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR11.0180	<Full>
<ALLOCATED_TO>	<Functional block>	Data Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRFP.0104
Requirement	Airspace Users shall have procedures and means in place to get information about ATFCM restrictions applicable in the direct routing environment
Title	Information of AU about applicable ATFCM restrictions in direct routing environment
Status	<Validated>
Rationale	In order to be able to plan trajectories in direct routing environment, airspace user must be informed of the applicable ATFCM restrictions relating to flight planning. Particularly, direct routing operations brings more variability and could require new ATFCM restrictions. Additionally, long range direct routing could increase complexity and requires as well, new ATFCM restrictions. Baseline ATFCM restrictions includes regulations, scenario and conditions of use listed in RAD Appendix 4. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_012 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR11.0180	<Full>
<ALLOCATED_TO>	<Functional block>	Data Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRFP.0105
Requirement	In Direct Routing environment, the Airspace Users shall update the flight plan information with the required flight plan adjustment at the STAM measure implementation time
Title	Flight plan update for STAM in direct routing environment
Status	<Validated>
Rationale	STAM DCB implementation in Direct Routing environment is based on existing processes and services supporting the planning and execution of flights. Timely update of Flight Plan Information will allow more accurate demand prediction using the most up to date trajectory information.

	This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_012 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0673	<Full>
<ALLOCATED TO>	<Functional block>	Flight Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRFP.0106
Requirement	Airspace Users shall plan trajectories in Direct Routing environment in compliance with Direct Segment conditions of use
Title	Flight planning in compliance with direct segments conditions of use in direct routing environment
Status	<Validated>
Rationale	To enable Direct Routing operations, Airspace Users must be able to plan valid trajectories in the Direct Routing environment. As it is requested today with en-route DCTs published in RAD Annex 4, AU's need to comply with conditions of use of published direct segments (time restriction, area restriction, flow restriction). For Airspace Users with FOC, this will be facilitated by the use of suitable flight planning systems. This requirement is justified by Safety Assessment: see Safety Objective SO DRA 011 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR11.0181	<Full>
<ALLOCATED_TO>	<Functional block>	Flight Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRFP.0107
Requirement	Airspace Users shall submit a flight plan compliant with the ATFCM restrictions applicable in the direct routing environment
Title	Flight planning in compliance with ATFCM restrictions in direct routing environment
Status	<Validated>
Rationale	To enable Direct Routing operations, Airspace Users must be able to plan valid trajectories in the Direct Routing environment. New ATFCM restrictions might be required for cross border direct routing operations in high complexity environment. Baseline ATFCM restrictions includes regulations, scenario and conditions of use listed in RAD Appendix 4. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_012 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>

Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR11.0181	<Full>
<ALLOCATED_TO>	<Functional block>	Flight Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRFP.0108
Requirement	Wherever a Direct Routing Airspace is published, Airspace Users shall plan trajectories in DRA respecting its availability
Title	Flight planning in compliance with DRA availability
Status	<In Progress>
Rationale	To enable Direct Routing operations, Airspace Users must be able to plan valid trajectories in the Direct Routing environment. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_010 of the Safety Assessment Report in section A.1.1 The live trials (WE-FREE, FREE Solutions) that demonstrated the concept of Free Route through Direct Routings including across ACC/FIR borders have not been performed in a published DRA. It is recommended to complete the validation of this requirement during the pre-operational phase in the local environments where a DRA is envisaged to be published.
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR11.0160	<Full>
<ALLOCATED_TO>	<Functional block>	Flight Management	N/A

3.1.1.1.2 Functional safety requirements for BT/MT Flight Execution

[REQ]

Identifier	REQ-04.07.02-SPR-DRFE.0101
Requirement	Pilot shall be informed of direct routings lower limit and of potential impacts in case of non-compliance with this constraint (possible rerouting)
Title	Training / familiarisation of the pilots on direct routings lower limit
Status	<Validated>
Rationale	Requirement relating to training/familiarisation of pilots. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_036 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-07.02-DOD-0001.0002	<Partial>

3.1.1.1.3 Functional safety requirements for Airspace Management

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.0101
Requirement	Direct routings and direct segments shall be designed so as to induce a manageable level of airspace complexity for ATCOs
Title	Design of manageable direct segments
Status	<Validated>
Rationale	Direct routings and direct segments are not purely designed based on the needs from airspace users. Some ATC constraints can be considered during the design phase in order to ensure that the direct routing network will be manageable safely by ATCO. Particularly, number of direct segments inducing conflicts at sector/ATSU boundaries need to be limited. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_006 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0111	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.0102
Requirement	The maximum length of the direct routing / direct segment shall take into account ATC operational and technical constraints
Title	Maximum length of direct segments
Status	<Validated>
Rationale	Long direct segments can induce operational and technical issues for ATC: • Operational aspects: It can be an issue to resume navigation in the case of long range direct routing (if next waypoint is located in another sector/ATSU) • Technical aspects: next waypoint might not be known by the technical system if it is located in another ATSU This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_008 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0111	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.0103

Requirement	Wherever the fixed ATS route network is removed for direct routings, a Direct Routing Airspace shall be published in national AIS Publications
Title	Direct Routing Airspace Publication in AIP
Status	<Validated>
Rationale	If fixed ARN is removed inside DRA, Airspace Users have to be aware of Direct Routing Airspace dimension. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_002 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0110	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.0104
Requirement	The limits and condition of use of the Direct segments constituting a Direct Routing shall be published in the RAD
Title	Direct Segments Publication in a Direct Routing environment
Status	<Validated>
Rationale	Airspace Users have to be notified about condition of use of Direct Segments which have to be kept as simple as possible. Limits and conditions of use (if any) of Direct segments are defined in RAD Appendix 4 (En-route DCT segments, horizontal and vertical DCT limits, and compulsory Direct routings) and Appendix 7 (about FUA restrictions and affected DCTs). Conditions of use can include direct routing time availability. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_004 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0111	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.0105
Requirement	Wherever a Direct Routing Airspace is published, its Entry, Exit, Arrival, Departure and Intermediate Points shall be published in national AIS Publications (using standard ICAO format description)
Title	Publication of Points in a Direct Routing environment
Status	<Validated>
Rationale	If fixed ARN is removed inside DRA, AUs have to be notified about Entry/Exit points where Direct Routings start/end, as well as about exit, arrival and intermediate point. All points to be used for flight planning have to conform to current ICAO standards in order to allow exchange between relevant parties.

	This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_002 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0113	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.0106
Requirement	The setting of the lower limit of Direct Routing Airspace shall not adversely impact safety of operations in any adjacent/subjacent non-DRA volume
Title	No safety impact from DRA lower limit
Status	<Validated>
Rationale	Direct Routing Airspace has to facilitate transition to and from non-DRA airspace The parameters to be taken into account to facilitate this transition include: traffic flows, complexity of traffic, sector capacity and safety aspects in DRA (and adjacent) airspace. Balance has to be found between safety & capacity. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_003 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0120	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.0107
Requirement	The vertical connection between Direct Routing network and the underlying fixed ATS route network shall take into account the various climbing and descending profiles
Title	Smooth connectivity between Direct Routing network and underlying fixed ATS route
Status	<Validated>
Rationale	The smooth connectivity between Direct Routing network and the underlying fixed ATS route network is achieved considering climbing and descending profiles. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_007 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0121	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.0108
Requirement	Wherever a Direct Routing Airspace is published, its entry and exit points shall be connected to the underlying and to the adjacent fixed ATS Route Network by Direct Segments or fixed ATS route segments if maintained in the airspace
Title	Determination of DRA Entry and Exit points
Status	<Validated>
Rationale	A Direct Routing Airspace has to facilitate transition to and from non-Direct Routing Airspace taking into account the possible effects on: - Controller workload - Flight Planning - Letters of agreement. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_003 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0130	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.0109
Requirement	Wherever the fixed ATS route network is removed within a Direct Routing Airspace and flight planning through Airspace Reservations is not allowed, Direct Routings shall be defined to allow safe flight planning around ARES
Title	Publication of Direct Routings around ARES in DRA without ARN
Status	<Validated>
Rationale	Published Direct Routings around ARES in Direct Routing Airspace without fixed ATS route network are required for flight planning by Airspace Users. The design of Direct routings needs to take into account the fixed ARES configurations to ensure that the correct volume of airspace is avoided by the published Direct segments. In execution phase, Intermediate points along these Direct Routings will enable ATCO to reroute traffic tactically to avoid unforeseen or ad-hoc ARES activation. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_005 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0150	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.0110
Requirement	Civil/military ATM coordination arrangements and procedures applying to the Direct Routing environment shall be determined and approved prior to their provision to ATCOs
Title	Civil/military arrangements and procedures in Direct Routing environment
Status	<Validated>
Rationale	To enable fligh planning options of Direct Routing during military operating hours of military areas, arrangements between civil and military partners are needed. All arrangements about military activity/Direct Routing availability/circumnavigation procedure or coordination applying to the Direct Routing environment need to be determined and approved between civil and military partners. ATCOs need to be provided with those new Civil/Military procedures applying to the Direct Routing environment. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_013 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0211	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.0111
Requirement	In Direct Routing environment, sectors shall be designed to accommodate traffic flows including flows on direct segments
Title	Sector Design in Direct Routing environment
Status	<Validated>
Rationale	Sector design criteria should, at least, take into account: • The principle traffic flows and orientation; • Minimizing short transits through sectors; • Minimizing sector and ACC re-entry; • Positions of airspace reservations; • Coherency with adjoining fixed route sectors and link routes to SIDs and STARs; • Civil / military coordination aspects. This requirement only relate to sector design. Adaptation of sector configuration to deal with direct routing traffic flow is covered by another requirement. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_009 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DODSAF1.0020	<Partial>

3.1.1.1.4 Functional safety requirements for ATFCM (Plan Network Resources & Capabilities)

[REQ]

Identifier	REQ-04.07.02-SPR-DRFM.0101
Requirement	Sector capacities and monitoring values shall be adapted to direct routing operations
Title	Capacity threshold of the sectors in direct routing environment
Status	<Validated>
Rationale	The local capabilities (threshold in terms of entry rate and occupancy rate defined to ensure a workload manageable by the ATCO) are based on historical data and might need to be slightly adapted in direct Routing environment. Thresholds in degraded mode (severe weather condition, failure of major ATC system…) also need to be adapted. These adaptations are defined keeping in mind that the global airspace capacity needs to be maintained (see other requirement relating to airspace capacity). This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_018 and SO_DRA_03 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DODSAF1.0020	<Partial>

3.1.1.1.5 Functional safety requirements for ATFCM (Balance Network Demand with Resources & Capabilities)

[REQ]

Identifier	REQ-04.07.02-SPR-DRFM.0111
Requirement	Catalogue of DCB/dDCB solutions shall be adapted to direct routing operations
Title	Catalogue of DCB/dDCB solutions in direct routing environment
Status	<Validated>
Rationale	Current catalogue of DCB/dDCB solution need to be revised to take into account the increased variability induced by direct routing operations. Catalogue of DCB solution can include predefined regulation, airspace configuration, scenario or STAM. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_019a of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A

<SATISFIES>	<ATMS Requirement>	REQ-04.02-DODSAF1.0020	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-DRFM.0112
Requirement	ATFCM restriction applicable in direct routing environment shall be defined and published in medium/short term planning phase
Title	Publication of ATFCM restriction in direct routing environment
Status	<Validated>
Rationale	AUs have to be aware of ATFCM restrictions to plan their trajectories accordingly. New kind of ATFCM might be necessary to take into account the increased variability induced by direct routing operations This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_017 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DODSAF1.0020	<Partial>

3.1.1.1.6 Functional safety requirements for Planning Separation Assurance

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0101
Requirement	In Direct Routing environment of high complexity, the Planning Controller shall be provided with procedures for ATSU/sector coordination of flights with unnamed Coordination Points
Title	Inter-sector coordination procedures adapted to Direct Routing operations
Status	<Validated>
Rationale	Possible lack of named Coordination Points for Direct Routings across ATSU/sector boundaries to support seamless Direct Routing operations. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_020 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0210	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0102
Requirement	In support to Direct Routing operations across ACC/FIR borders, the LoA shall be adapted to not necessarily refer to published route network or fixed coordination point
Title	Letter Of Agreement in Direct Routing environment
Status	<Validated>
Rationale	Today, acceptable handover conditions are often described with reference to the route structure and coordination point. In direct routing environment, these conditions will need to be revised, particularly for long range cross border direct routings. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_021 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0210	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0103
Requirement	In Direct Routing environment of high complexity, the Planning Controller shall be provided with tools to support coordination of flights across ATSU/sector boundaries with unnamed coordination points
Title	ATC coordination support tools adapted to Direct Routing operations
Status	<Validated>

Rationale	Coordination of flights in Direct Routing across ATSU/sector boundaries outside named Coordination Points will need to be supported by the ATC systems in order to assist the ATCOs in the identification of COPs This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_023 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0211	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0104
Requirement	In support to Direct Routing operations across ACC/FIR borders, any ATC procedure for ATSU/sector coordination shall be consistently applied by adjacent ATC service providers
Title	Consistent ATC coordination procedures for Direct Routing operations
Status	<Validated>
Rationale	Consistent ATC coordination procedures permit seamless Direct Routing operations and cross ACC boundary processing This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_020 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0214	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0105
Requirement	In Direct Routing environment, the ATCOs (Planning Controller and Tactical Controller) shall be able to remove a flight of her/his sector from the ordered list of sectors that are expected to assume a given flight
Title	SKIP function in Direct Routing environment
Status	<Validated>
Rationale	In direct routing environment, the direct transfer of flights from the n-1 to the n+1 sector (SKIP function) will permit to mitigate short crossings of the sector on a case-by-case basis. Short sector crossings are more likely in direct routing environment where design of the direct segment is based on airspace user needs. These possible short sector crossing are also mitigated by new sector design (see previous requirement in airspace management section). This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_022 of the Safety Assessment Report in section A.1.1
Category	<Safety>

Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0211	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0106
Requirement	In Direct Routing environment, the ATCOs (Planning Controller and Tactical Controller) shall be able to display the planned 2D trajectory of at least one selected flight
Title	Display of planned 2D trajectory in direct routing environment
Status	<Validated>
Rationale	In complex Direct Routing operations, the ATCO cannot build her/his mental image of the situation based on the literal flight plans only, because routes are unfamiliar (particularly in the case where a significant number of direct segments are published). Moreover, in case of a long range Direct segment, the waypoints may be far from the sector, consequently out of the ATCO knowledge. A tool allowing the simultaneously display of the planned 2D trajectory of several selected flights might be an option to comply with these requirement but is not mandatory. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_024 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0240	<Full>
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0107
Requirement	In Direct Routing environment of high complexity, the Planning Controller shall be provided with trajectory-based Conflict Detection Tool to support the mid-term detection of encounters between two flights
Title	Mid-term Conflict Detection support tool in Direct Routing environment
Status	<Validated>
Rationale	To manage Direct Routing operations in high complexity airspace (e.g. with dense or complex en-route DCT network inducing conflicts at the boundaries between sector/ATSU), the PC needs a support to assess the global air situation including flights that follow an unfamiliar route. Also conflicts may occur at border between two sectors and the PC needs a support to detect such conflicts in advance. A mid-term detection of encounters permits to predict potential loss of separation between two planned trajectories of interest for the sector (20 minutes time horizon as an order of magnitude). This requirement is justified by Safety Assessment: see Safety Objective

	SO_DRA_026 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0220	<Full>
<ALLOCATED TO>	<Functional block>	CONF	N/A
<ALLOCATED TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0108
Requirement	In Direct Routing environment of high complexity, ATCOs (Planning controller and Tactical controller) shall be informed in due time of ARES activation status (active/not active/released) within the area of interest of the sector
Title	Information of ARES activation status in direct routing environment
Status	<Validated>
Rationale	In direct routing environment where flight planning across ARES is allowed, ATCO need to be able to identify an active ARES in a neighbouring sector in order to propose a suitable coordination and avoid area infringement. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_027 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-07.02-DOD-0001.0002	<Full>
<ALLOCATED TO>	<Functional block>	CONF	N/A
<ALLOCATED TO>	<Functional block>	CHMI	N/A

3.1.1.1.7 Functional safety requirements for Tactical Separation Assurance

[REQ]

Identifier	REQ-04.07.02-SPR-DRTC.0101
Requirement	ATCO of upstream sector shall be aware of the Direct Routings lower limit and give appropriate clearance to make it possible for the aircraft to be above this lower limit when reaching the Direct Routing entry point.
Title	Training / familiarisation of the ATCO on direct routings lower limit
Status	<Validated>
Rationale	Requirement relating to training of ATCO. If aircraft is not at the appropriate flight level (above Direct Routing lower limit) when reaching the first point of its user defined trajectory, it will affect the ATCO activities (aircraft flying an unexpected route). A training / familiarisation of the ATCO of lower limit of the airspace is needed in order to avoid this kind of situation. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_035 of the Safety Assessment Report in section A.1.1

Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-07.02-DOD-0001.0002	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-DRTC.0102
Requirement	In Direct Routing environment, FDPS database shall include all points of interest for the ATCO (e.g. all points within the maximum length of the direct segments including points outside the ATSU area of responsibility)
Title	FDPS database in Direct Routing environment
Status	<Validated>
Rationale	FDPS database needs to include some points of neighbouring area in order to avoid reception of flight plan with unknown points and consequently rejection of the flight plan. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_037 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-07.02-DOD-0001.0002	<Partial>
<ALLOCATED TO>	<Functional block>	FPLD	N/A

3.1.1.1.8 Functional safety requirements for Ensuring Trajectory Adherence

No functional safety requirement, but safety recommendations (see section A.2.1.1.6), relating to Trajectory Adherence monitoring in Direct Routing across ACC/FIR borders and in high complexity environments.

3.1.1.1.9 Functional safety requirements for Ground-Based Safety Nets

[REQ]

Identifier	REQ-04.07.02-SPR-DRSN.0101
Requirement	In Direct Routing environment, the ATCOs shall be assisted by a Short-Term Conflict Alert system
Title	Short-Term Conflict Alert (STCA) system in Direct Routing environment
Status	<Validated>
Rationale	Controllers need system assistance to prevent collisions between aircraft when confronted with a multitude of ever different trajectories in direct routing environment. In a Direct Routing environment, this is all the more true as the mix of Direct segments and fixed ATS Route segments can be complex to manage in the execution phase, at ATC level.

	This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_031 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0810	<Full>
<ALLOCATED_TO>	<Functional block>	SNET	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRSN.0102
Requirement	In Direct Routing environment, the ATCOs shall be assisted by an Area Proximity Warning system
Title	Area Proximity Warning (APW) system in Direct Routing environment
Status	<Validated>
Rationale	Controllers need system assistance to be warned in short-term of unauthorised penetration of flights (e.g., controlled flights into restricted airspace or uncontrolled flights into controlled area) when confronted with a multitude of ever different trajectories and management of ARES in direct routing environment. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_032 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0820	<Full>
<ALLOCATED_TO>	<Functional block>	SNET	N/A

3.1.1.2 Integrity safety requirements (failure case)

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0301
Requirement	The frequency of occurrence of an aircraft entering on a direct segment outside availability period shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft entering on a direct segment (DCT) outside availability period
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_DRA_101 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0111	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0302
Requirement	The frequency of occurrence of an aircraft below direct segment lower limit when reaching the entry point of the direct routing shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft below direct segment lower limit when reaching the entry point of the direct routing
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_DRA_102 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0111	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0303
Requirement	The frequency of occurrence of an aircraft descending below direct segment lower limit before reaching exit point shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft descending below direct segment lower limit before reaching exit point
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_DRA_103 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0111	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0304
Requirement	The frequency of occurrence of an aircraft entering the airspace on a direct segment crossing an active ARES (where tactical rerouting is not provided) shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft entering the airspace on a direct segment crossing an active ARES
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_DRA_104 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0111	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0305
Requirement	The frequency of occurrence of an aircraft flying a trajectory not compliant with ATFCM restrictions in direct routing environment shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft flying a trajectory not compliant with ATFCM restrictions in direct routing environment
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_DRA_105 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR11.0180	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0306
Requirement	The frequency of occurrence of a flight plan including points not known by the system and/or ATCO in direct routing environment shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of a flight plan including points not known by the system and/or ATCO in direct routing environment
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_DRA_106 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DODSAF1.0020	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0307
Requirement	The frequency of occurrence of a loss of inter sector/ATSU coordination tool in direct routing environment shall not be greater than 6.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of a loss of inter sector/ATSU coordination tool in direct routing environment
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO DRA 107 of the Safety Assessment

	Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a high complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0211	<Partial>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0308
Requirement	The frequency of occurrence of a loss of display of the planned trajectory in direct routing environment shall not be greater than 2.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of a loss of display of the planned trajectory in direct routing environment
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_DRA_108 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a high complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0240	<Partial>
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0309
Requirement	The frequency of occurrence of a discrepancy between ground and airborne trajectory in direct routing environment shall not be greater than 2.00E-04 per sector operational hour
Title	Maximum frequency of occurrence of a discrepancy between ground and airborne trajectory in direct routing environment
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety

	Assessment: see Safety Objective SO_DRA_109 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a high complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0240	<Partial>
<ALLOCATED TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0310
Requirement	The frequency of occurrence of a loss of tactical trajectory adherence monitoring tool when available in direct routing environment shall not be greater than 2.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of a loss of route adherence monitoring tool in direct routing environment
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_DRA_110 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0250	<Full>
<ALLOCATED TO>	<Functional block>	MONA	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0311
Requirement	The frequency of occurrence of a loss of mid-term conflict detection tool in direct routing environment shall not be greater than 2.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of a loss of mid-term conflict detection tool in direct routing environment
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_DRA_111 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a high complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the

	safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0220	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0312
Requirement	The frequency of occurrence of an erroneous mid-term conflict detection in direct routing environment (one conflict not detected by the tool) shall not be greater than 6.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of an erroneous mid-term conflict detection in direct routing environment
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_DRA_112 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a high complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0220	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0313
Requirement	The frequency of occurrence of a loss of tactical conflict detection tool when available in direct routing environment shall not be greater than 6.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of a loss of tactical conflict detection tool in direct routing environment
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_DRA_113 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a high complexity sector during one hour is of 6 flight hours controlled

	per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0190	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-DR00.0314
Requirement	The frequency of occurrence of an erroneous tactical conflict detection when available in direct routing environment (one conflict not detected by the tool) shall not be greater than 6.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of an erroneous tactical conflict detection in direct routing environment
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_DRA_114 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a high complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0230	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

3.1.2 Performance Requirements

3.1.2.1 Performance requirements for BT/MT Flight Planning

No performance requirement relating to BT/MT Flight Planning for Direct Routing across ACC borders and in high complexity environments.

3.1.2.2 Performance requirements for Airspace Management

3.1.2.2.1 Operational Efficiency (including fuel efficiency)[9]

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.1001
Requirement	Direct Routings shall be designed in a way that operational flight efficiency is improved thanks to the provision of more flight planning options to Airspace Users
Title	Flight efficiency improvement in Direct Routing environment
Status	<Validated>
Rationale	Due to a possible reduction in flight plan route distance (compared the conventional ATS route network) OR due to a possible more efficient flight plan route (in terms of fuel efficiency and business/mission effectiveness) through the use of long-range direct routings designed along major traffic flows and/or short-range direct segments providing short-cuts to the ATS Route Network.
Category	<Performance>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0101	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.1002
Requirement	The condition of use of Direct Segments constituting the Direct Routing Network shall be kept as simple as possible
Title	Simple condition of use of Direct Segments in a Direct Routing environment
Status	<Validated>
Rationale	Conditions of use of direct segments are defined in RAD Appendix 4 and Appendix 7. Simple RAD conditions are more manageable by Airspace Users and will increase the operational use of Direct Routings. If RAD conditions of use are too complex, ATS routes would be preferred by airspace users.
Category	<Performance>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0140	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.1003
Requirement	In Direct Routing environment of high complexity, the publication of cross-border Direct Routings shall be endeavoured

[9] Operational efficiency for airspace users has been identified as key within the SESAR R&D framework (although not formally part of the B.05 Performance Framework). In the European ATM master Plan Edition 2015 [20], operational efficiency is translated into measurements of delay and fuel savings, in order to be useable by the SES Performance Scheme under the environment and capacity KPAs.

Title	Cross-Border horizontal limit of Direct Routing environment
Status	<Validated>
Rationale	In order to maximize efficiency of Direct Routing Network, Direct Routings - with or without published cross-border Direct Segments - need to be extended across ACC/FIR boundaries into high complexity airspace.
Category	<Performance>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0112	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.1004
Requirement	In Direct Routing environment, availability time of Long Range Direct Routings during military operating hours of military areas shall be coordinated between civil and military
Title	AFUA coordination for Direct Routing availability time
Status	<Validated>
Rationale	In the perspective of providing Direct Routing flight planning options to the Airspace Users during military operating hours of military areas, coordination with military partners is needed in order to optimise the use of Long Range Direct Routings and to maximize their availability time. However, as Direct Routings are not published as such, their availability time has to be reflected in its constituting Published Direct Segments through settings of appropriate time restriction as conditions of use. Conditions of availability of direct segments constituting the long range direct routing are not necessarily the same.
Category	<Performance>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0210	<Full>
<ALLOCATED_TO>	<Functional block>	Cooperative Airspace Management	N/A

3.1.2.2.2 Capacity

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.1005
Requirement	Direct Routings shall be designed so as to induce manageable level of airspace complexity for ATCOs
Title	Airspace complexity in Direct Routing environment
Status	<Validated>
Rationale	In order to maximize airspace capacity, Direct Routings have to be designed in a way that it is possible to maintain sector team workload acceptable (e.g. limited number of DCTs inducing conflicts at sector/ATSU boundaries).
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance

<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0120	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.1006
Requirement	Wherever a Direct Routing Airspace is published, the setting of the lower limit of Direct Routing Airspace shall not adversely impact on capacity of any adjacent/subjacent non-DRA volume
Title	Lower limit of Direct Routing Airspace
Status	<Validated>
Rationale	Direct Routing Airspace has to facilitate transition to and from non-DRA airspace.
Category	<Performance>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0120	<Full>

3.1.2.3 Performance requirements for ATFCM (Plan Network Resources & Capabilities)

3.1.2.3.1 Capacity

[REQ]

Identifier	REQ-04.07.02-SPR-DRFM.1001
Requirement	Direct Routing Operations shall not compromise Airspace Capacity
Title	Airspace Capacity in Direct Routing environment
Status	<Validated>
Rationale	The current ATM system cannot afford a loss of capacity due to Direct Routing operations.
Category	<Performance>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-CAP2.0004	<Full>

3.1.2.3.2 Predictability

[REQ]

Identifier	REQ-04.07.02-SPR-DRFM.1002
Requirement	Direct Routing Operations shall not adversely impact ATFCM delays
Title	Predictability in Direct Routing environment
Status	<Validated>
Rationale	The current ATM system cannot afford an increase of ATFCM delays due to Direct Routing operations.
Category	<Performance>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-PRD1.0010	<Full>

3.1.2.4 Performance requirements for Planning Separation Assurance

3.1.2.4.1 System Performance

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.1001
Requirement	In Direct Routing environment of high complexity, flight data distribution shall be possible across ATSU/sector boundaries with unnamed Coordination Points
Title	Flight data distribution in Direct Routing environment
Status	<Validated>
Rationale	Coordination of flights in Direct Routing across ATSU/sector boundaries outside named Coordination Points will need to be supported by the ATC Flight Data Processing and Distribution systems.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0211	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	FPLD	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.1002
Requirement	In Direct Routing environment of high complexity, the display of planned 2D trajectory of a selected flight shall be possible via direct access on the CWP HMI
Title	Easy display of selected planned 2D trajectory in Direct Routing environment
Status	<Validated>
Rationale	In complex Direct Routing environment, a tool allowing the display of the planned 2D trajectory of at least one selected flight is essential for ATCOs to build her/his mental image of the situation. To be efficient, the access to the display the selected trajectory needs to be direct.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0240	<Full>
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.1003
Requirement	In Direct Routing environment of high complexity, the display of planned 2D trajectory of a selected flight shall be instantaneous
Title	Prompt display of selected planned 2D trajectory in Direct Routing

	environment
Status	<Validated>
Rationale	In complex Direct Routing environment, a tool allowing the display of the planned 2D trajectory of at least one selected flight is essential for ATCOs to build her/his mental image of the situation. To be efficient, the tool needs to display the selected trajectory without delay.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0240	<Full>
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.1004
Requirement	In Direct Routing environment where long Direct segments may be planned, the CD/R Tool for PC shall consider that Direct segments are portions of Great Circles
Title	Trajectory Prediction using Great Circles in Direct Routing environment
Status	<Validated>
Rationale	There may be a several miles gap between the Great Circle and the linear segment between two distant points, which is not acceptable for Separation purpose For information: in the current fixed route network, the route segments are short enough to be modelled as straight lines.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0223	<Full>
<ALLOCATED_TO>	<Functional block>	TP&M	N/A
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	MONA	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.1005
Requirement	In Direct Routing environment of high complexity, the Conflict Detection Tool for PC shall perform mid-term detection of encounters between flights as soon as the flights are distributed (and not necessarily assumed) in the sector
Title	Timeliness of Mid-term Conflict Detection support tool in Direct Routing environment
Status	<Validated>
Rationale	To manage complex Direct Routing operations, the Conflict Detection Tool for PC is essential to support the mid-term detection of encounters. To be efficient, the tool needs to detect mid-term encounters as soon as possible prior to the entry into the sector.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0220	<Full>
<ALLOCATED_TO>	<Functional block>	TP&M	N/A
<ALLOCATED_TO>	<Functional block>	CONF	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.1006
Requirement	In Direct Routing environment of high complexity, the Conflict Detection Tool for PC shall perform mid-term detection of encounters between two flights in a permanent and continuous way
Title	Continuity of Mid-term Conflict Detection support tool in Direct Routing environment
Status	<Validated>
Rationale	To manage complex Direct Routing operations, the Conflict Detection Tool for PC is essential to support the mid-term detection of encounters. To be efficient, the tool needs to detect mid-term encounters in a permanent and continuous way.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0220	<Full>
<ALLOCATED_TO>	<Functional block>	TP&M	N/A
<ALLOCATED_TO>	<Functional block>	CONF	N/A

3.1.2.5 Performance requirements for Tactical Separation Assurance

3.1.2.5.1 Human Performance

[REQ]

Identifier	REQ-04.07.02-SPR-DRTC.1001
Requirement	In Direct Routing environment of high complexity, the ATCOs (Planning Controller and Tactical Controller) shall be provided with a tool to determine the minimum distance between two selected aircraft based on the current state vectors
Title	Tool for determination of the minimum distance between two selected flights in Direct Routing environment
Status	<Validated>
Rationale	With no classical route scheme, the ATCO needs a support to analyse the air situation and notably the potential loss of separation based on the current state vectors
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-HMI.0001	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

3.1.2.5.2 System Performance

[REQ]

Identifier	REQ-04.07.02-SPR-DRTC.1002
Requirement	When available in Direct Routing environment, the Conflict Detection Tool for TC shall perform detection of tactical encounters involving at least one eligible flight
Title	Eligibility for detection of tactical encounters by Conflict Detection tool in Direct Routing environment
Status	<Validated>
Rationale	Eligible flights for Tactical Conflict Detection tool are to be determined taking into account the relevant local factors and procedures, e.g. flights released by the upstream sector, assumed flights or flights released and not yet assumed to the down-stream sector.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0230	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRTC.1003
Requirement	When available in Direct Routing environment, the Conflict Detection Tool for TC shall detect tactical encounters between two flights within a predefined time horizon of at least X minutes up to Y minutes
Title	Time horizon of Tactical Conflict Detection support tool in Direct Routing environment
Status	<Validated>
Rationale	In Direct Routing environment of high complexity, the TC would need a support to assess tactical situations involving flights that do not follow any familiar route scheme (particularly when a lot of direct segments are published). A detection of tactical encounters permits to predict potential loss of separation between two tactical trajectories within a maximum time horizon (typically 8 minutes as an order of magnitude). A minimum time horizon (at least 4mn as an order of magnitude) is also needed for the TC to assess the air situation and take appropriate action if necessary to maintain separation between flights. To accommodate local relevant factors, this time horizon parameter should be locally configurable and assessed according to the sector design.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0230	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRTC.1004

Requirement	When available in Direct Routing environment, the Conflict Detection Tool for TC shall detect tactical encounters between two flights in a permanent and continuous way
Title	Continuity of Tactical Conflict Detection support tool in Direct Routing environment
Status	<Validated>
Rationale	To manage complex Direct Routing operations, the Conflict Detection Tool for TC might be an option to support the detection of tactical encounters. To be efficient when available, the tool needs to detect tactical encounters in a permanent and continuous way.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0230	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

3.1.2.6 Performance requirements for Ensuring Trajectory Adherence

No performance requirement relating to Trajectory Adherence monitoring in Direct Routing across ACC/FIR borders and in high complexity environments.

3.2 SESAR Solution #33 - Free Routing across ACC/FIR within permanently low to medium complexity environments

Note to the reader: An airspace considered as of medium complexity in current ARN environment can become of high complexity when Free Routing operations are introduced. Also when extended geographical FRA implementation, the potentially high variability of the traffic demand could lead to a high complexity in a sector generally considered as low to medium complexity, thus potentially entailing new requirements to cope with peaks of demand, even if only necessary on occasional bases.

It is therefore worthwhile noting that the Solution #33 described in this document only applies in case of a FRA of permanently low to medium complexity environments. Further work will be required in SESAR 2020 to define the potentially new requirements to support FRA operations in temporary or permanent high complexity environments.

3.2.1 Safety Requirements

Following sections presents the safety requirements derived for solution #33:

- Functional safety requirements derived from the success approach and the failure approach (to mitigate system-generated hazards) are listed in section 3.2.1.1,
- Integrity safety requirements derived from the failure approach (expressed in terms of maximum probability of occurrence) are listed in section 3.2.1.2.

3.2.1.1 Functional safety requirements (success case)

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0101
Requirement	The safety of Free Routing operations shall be maintained at or above the current level
Title	Not compromise safety in Free Routing Airspace
Status	<Validated>
Rationale	No improvement of the overall En Route safety level is expected due to the implementation of Free Routing operations. Many potential issues have been identified during the initial phases of the Safety Assessment. Appropriate solutions and tools need to be implemented to deal with these issues and maintain the level of safety before implementation of FRA (see Safety Assessment Report in section A.1.1).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DODSAF1.0020	<Full>

3.2.1.1.1 Functional safety requirements for BT/MT Flight Planning

[REQ]

Identifier	REQ-04.07.02-SPR-FRFP.0101
Requirement	ANSP, Airspace Users and Network Manager shall have the same level of information in flight planning phase regarding flight profile and routing in

	Free Routing Airspace
Title	Flight profile information collection and distribution in FRA
Status	<Validated>
Rationale	Such “level of information” will concern both the initial flight plan intentions and any subsequent revisions to this information. Same level of information does not necessarily means same data. Meaning of “same level of information” will need to be clarified later on This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_001 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0110	<Full>
<ALLOCATED_TO>	<Functional block>	Flight Management	N/A
<ALLOCATED_TO>	<Functional block>	FPLD	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRFP.0102
Requirement	Airspace Users shall have procedures and means in place to get information about the airspace volume availability in Free Routing Airspace (e.g. ARES)
Title	Information of AU about FRA volume availability
Status	<Validated>
Rationale	In order to be able to plan trajectories in FRA Airspace Users must obtain information about the FRA volume availability and process this information in a way it can be used for flight planning. For Airspace Users with FOC, this processing will be facilitated by the use of suitable flight planning systems. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_005 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0160	<Full>
<ALLOCATED_TO>	<Functional block>	Data Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRFP.0103
Requirement	Airspace Users shall have procedures and means in place to get information about the Free Routing Airspace time availability (e.g. Night FRA)
Title	Information of AU about FRA time availability
Status	<Validated>
Rationale	In order to be able to plan trajectories in FRA Airspace Users must obtain information about the FRA time availability and process this information in a way it can be used for flight planning. For Airspace Users with FOC, this processing will be facilitated by the use of suitable flight planning systems

	This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_009 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0170	<Full>
<ALLOCATED_TO>	<Functional block>	Data Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRFP.0104
Requirement	Airspace Users shall have procedures and means in place to get information about the flight planning rules in the Free Routing Airspace. They include: • Allowed segment lengths (minimum/maximum) • Usable points for flight planning • Entry/exit conditions (both horizontal and vertical)
Title	Information of AU about FRA flight planning rules
Status	<Validated>
Rationale	In order to be able to plan trajectories in FRA Airspace Users must obtain information about the flight planning rules in the FRA and process them in a way they can be used for flight planning. For Airspace Users with FOC, this processing will be facilitated by the use of suitable flight planning systems This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_010 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0180	<Full>
<ALLOCATED_TO>	<Functional block>	Data Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRFP.0105
Requirement	Airspace Users shall plan trajectories in Free Routing Airspace respecting its availability and the applicable flight planning rules
Title	Flight planning by AU in FRA
Status	<Validated>
Rationale	To enable Free Routing operations, Airspace Users must be able to plan valid trajectories in the FRA. Flight planning rules includes: entry/exit conditions from/to adjacent airspace, transition conditions from/to lower/upper airspace, period of availability of the airspace, min/max length of the segments, possibility to plan user defined points and other general flight planning rules such as FLOS Flight Level assignment according to direction of flight is one of the conditions of use of an airspace structure. This condition is still applicable in a Free Routing Airspace.

	This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_009 and SO_FRA_010 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0190	<Full>
<ALLOCATED TO>	<Functional block>	Flight Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRFP.0106
Requirement	In Free Routing Airspace, Airspace Users shall, in the flight planning phase, avoid active ARES where tactical re-routing is not provided
Title	Avoidance of active ARES in FRA
Status	<Validated>
Rationale	Airspace Users need to submit a flight plan compliant with ARES availabilities in order to prevent infringement of active ARES during execution phase. When AFUA is implemented, dimension of the active ARES might be different from one day to the other. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_012 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0120	<Full>
<ALLOCATED TO>	<Functional block>	Flight Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRFP.0107
Requirement	Airspace Users shall plan trajectories in Free Routing Airspace respecting the applicable ATFCM restrictions (e.g. volume-based constraints, FL capping)
Title	Flight planning in accordance with ATFCM restrictions in FRA
Status	<In Progress>
Rationale	Airspace Users need to submit a flight plan compliant with ATFCM restrictions in order to prevent peak of traffic/complexity during execution phase. New kind of ATFCM restrictions (volumes based constraints) might be defined in Free Routing Airspace. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_011 of the Safety Assessment Report in section A.1.1 To be fully validated (at V3 level), large-scale real-time simulation or live trial would be required notably with volume-based ATFCM restrictions in the airspace (which has not been the case in the OFA03.01.03 validation exercises). It is recommended to complete the validation of this requirement (and more generally of the enhanced ATFCM processes required to manage air traffic flows and airspace capacity in FRA) within SESAR 2020.

Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0140	<Full>
<ALLOCATED_TO>	<Functional block>	Flight Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRFP.0108
Requirement	In Free Routing Airspace, the Airspace Users shall update the flight plan information with the required flight plan adjustment at the STAM measure implementation time
Title	Flight plan update for STAM in FRA
Status	<Validated>
Rationale	STAM DCB implementation in FRA is based on existing processes and services supporting the planning and execution of flights. Timely update of Flight Plan Information will allow more accurate demand prediction using the most up to date trajectory information. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_011 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0673	<Full>
<ALLOCATED_TO>	<Functional block>	Flight Management	N/A

3.2.1.1.2 Functional safety requirements for BT/MT Flight Execution

[REQ]

Identifier	REQ-04.07.02-SPR-FRFE.0101
Requirement	Pilot shall be informed of FRA lower limit and of potential impacts in case of non-compliance with this constraint (not possible to fly their user preferred route)
Title	Training / familiarisation of the pilots on FRA lower limit
Status	<Validated>
Rationale	Requirement relating to training/familiarisation of pilots. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_041 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-07.02-DOD-0001.0002	<Partial>

3.2.1.1.3 Functional safety requirements for Airspace Management

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.0101
Requirement	The horizontal and vertical limits of the Free Routing airspace shall be published in national AIS Publications
Title	Publication of FRA limits in AIP
Status	<Validated>
Rationale	AUs have to be aware of Free Routing Airspace dimension to plan their trajectories accordingly. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_002 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0110	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.0102
Requirement	The Flight Level Orientation Scheme (FLOS) applicable within Free Routing operations airspace shall be promulgated through national AIS publications
Title	Publication of applicable FLOS within FRA in AIP
Status	<Validated>
Rationale	AUs have to be aware of the FLOS inside Free Routing Airspace to plan their trajectories accordingly. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_002 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0112	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.0103
Requirement	FRA Entry/Exit points, Arrival/Departure connecting points and published Intermediate points shall be promulgated in national AIS Publication
Title	Publication of entry/exit, Arrival/departure and Intermediate points in FRA
Status	<Validated>
Rationale	A Free Routing Airspace has to facilitate Free Routing operations inside the airspace, as well as transition to and from non-Free Routing Airspace. Published (5LNC) Intermediate points in FRA will also ease flight planning by some AUs. All points to be used for flight planning have to conform to current ICAO

	standards in order to allow exchange between relevant parties. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_002 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0113	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.0104
Requirement	Flight planning rules applicable inside the free routing airspace shall be published
Title	Publication of applicable flight planning rules within FRA
Status	<Validated>
Rationale	AUs have to be aware of the flight planning rules inside Free Routing Airspace to plan their trajectories accordingly. Flight planning rules includes: entry/exit conditions from/to adjacent airspace, transition conditions from/to lower/upper airspace, period of availability of the airspace, min/max length of the segments, possibility to plan user defined points and other general flight planning rules such as FLOS This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_003 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0113	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.0105
Requirement	In case of limited time availability of the Free Routing Airspace, procedures for transitioning between free routing and fixed route operations shall be set
Title	Transition between free routing and fixed route operations
Status	<Validated>
Rationale	Procedure need to be defined to cope with transition period and ensure that transition will be managed safely (e.g. “time buffer” in FRA availability period taking into account the traffic demand). Example of SEAFRA: SEAFRA is one FRA area over Bosnia, Serbia and Croatia FL325+. The FRA is active at night only (2300-0500 winter, 2200-0400 summer) and during FRA operations the ATS route network disappears FL 325+. To ease flight planning and the transition, the ATS route network remains available 30 mins after the beginning of the FRA and re-appears 30 minutes before the FRA stops. For any DCT between two points, ETO both points needs to be within the

	FRA times. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_0039 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0113	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.0106
Requirement	The setting of the lower limit of Free Routing Airspace shall not adversely impact safety of operations in any adjacent/subjacent non-FRA volume
Title	No safety impact from lower limit of FRA
Status	<Validated>
Rationale	Free Routing Airspace has to facilitate transition to and from non-FRA airspace. The parameters to be taken into account to facilitate this transition include: traffic flows, complexity of traffic, sector capacity and safety aspects in FRA (and non-FRA) airspace. Balance is to be found between safety & capacity (traffic complexity inside and outside FRA will depend on the FRA lower limit). This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_002 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0120	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.0107
Requirement	When defined, departure connecting ATS routes towards Free Routing Airspace shall be designed to ensure that most aircraft will be able to reach the FRA lower limit
Title	Design of departure connecting ATS route towards FRA
Status	<Validated>
Rationale	Aircraft departing from an airport below the free routing area might use departure connecting ATS route to join the free routing airspace. In order to be sure that most of the aircraft will be able to reach the free routing airspace at the appropriate flight level (above FRA lower limit), there is a need to ensure that the transition departure route will be long enough This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_004 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0120	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.0108
Requirement	Entry/Exit Points and Arrival/Departure Points of Free Routing Airspace shall ensure connectivity with non-FRA adjacent airspace
Title	Connectivity between FRA and non-FRA adjacent airspace
Status	<Validated>
Rationale	A Free Routing Airspace has to facilitate transition to and from non-Free Routing Airspace taking into account the possible effects on: - Controller workload - Flight Planning - Letters of agreement. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_002 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0130	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.0109
Requirement	Together with the ARES publication, the dimension of the Flight Buffer Zone applicable to flight planning in Free Routing Airspace shall be published
Title	Publication of FBZ in FRA
Status	<Validated>
Rationale	FBZ concept has to be embedded in the information associated with ARES to ensure that the correct volume of airspace to be avoided is notified to and interpreted by all actors in the same way. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_006 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0220	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.0110
Requirement	ASM tools shall be adapted to enable booking of ARES in Free Routing environment and interface with all actors e.g. other ASM tools, NM and ATC systems

Title	Airspace booking in Free Routing Airspace
Status	<In Progress>
Rationale	ASM tools will be used by AUs to make their demands and the system shall allow to interface with them. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_007a of the Safety Assessment Report in section A.1.1 To be fully validated (at V3 level), large-scale real-time simulation or live trial involving all ASM actors would be required (which has not been the case in the OFA03.01.03 validation exercises). It is recommended to complete the validation of this requirement within SESAR 2020.
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0230	<Full>
<ALLOCATED_TO>	<Functional block>	Cooperative Airspace Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.0111
Requirement	In Free Routing Airspace, sector shall be designed to accommodate free routing traffic flows
Title	Sector Design in FRA
Status	<Validated>
Rationale	Sector design criteria should, at least, take into account: • The principle traffic flows and orientation; • Minimizing short transits through sectors; • Minimizing sector and ACC re-entry; • Positions of airspace reservations; • Coherency with adjoining fixed route sectors and SIDs and STARs connecting ATS routes to/from FRA; • Civil / military coordination aspects. This requirement only relate to sector design. Adaptation of sector configuration to deal with free routing traffic flow is covered by another requirement. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_008 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0410	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.0112
Requirement	Civil/military ATM coordination arrangements and procedures applying to the Free Routing environment shall be determined and approved prior to their provision to ATCOs

Title	Civil/military arrangements and procedures in Free Routing environment.
Status	<Validated>
Rationale	To enable fligh planning options of Free Routing during military operating hours of military areas, arrangements between civil and military partners are needed. All arrangements about military activity/Free Routing availability/circumnavigation procedure or coordination applying to the Free Routing environment need to be determined and approved between civil and military partners. ATCOs need to be provided with those new Civil/Military procedures applying to the Free Routing environment. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_007b of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0230	<Full>

3.2.1.1.4 Functional safety requirements for ATFCM (Plan Network Resources & Capabilities)

[REQ]

Identifier	REQ-04.07.02-SPR-FRFM.0101
Requirement	Sector capacities and monitoring values shall be adapted to free routing operations
Title	Capacity threshold of the sectors in FRA
Status	<Validated>
Rationale	The local capabilities (threshold in terms of entry rate and occupancy rate defined to ensure a workload manageable by the ATCO) are based on historical data and might need to be slightly adapted in Free Routing environment. Thresholds in degraded mode (severe weather condition, failure of major ATC system…) also need to be adapted. These adaptations are defined keeping in mind that the global airspace capacity needs to be maintained (see other requirement relating to airspace capacity). This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_016 & SO_FRA_038 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0410	<Full>

[REQ]

3.2.1.1.5 Functional safety requirements for ATFCM (Balance Network Demand with Resources & Capabilities)

[REQ]

Identifier	REQ-04.07.02-SPR-FRFM.0111
Requirement	Catalogue of DCB/dDCB solutions shall be adapted to free routing operations
Title	Catalogue of DCB/dDCB solutions in FRA
Status	<Validated>
Rationale	Current catalogue of DCB/dDCB solution might be based on route network. and consequently might need to be revised Catalogue of DCB solution can include predefined regulation, airspace configuration, scenario or Short-Term ATFCM Measures. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_021 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0510	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRFM.0112
Requirement	Any mandatory usage of SID/STARs and connecting ATS routes in order to structure traffic flows to/from Free Routing Airspace shall be reflected in the RAD
Title	Mandatory connecting ATS routes to/from FRA
Status	<Validated>
Rationale	In high density/multiple airport terminal areas, there may be a mandatory usage of SID/STARs and connecting ATS routes in order to structure traffic flows. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_020 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0510	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRFM.0113
Requirement	ATFCM restrictions applicable in the free routing airspace shall be defined and published in medium/short term planning phase
Title	Publication of ATFCM restriction in FRA
Status	<In Progress>

Rationale	AUs have to be aware of ATFCM restrictions to plan their trajectories accordingly. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_017 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0510	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRFM.0114
Requirement	ATFCM restrictions applicable inside the free routing airspace shall be based on volume (not based on route/point) in free routing airspace.
Title	Volume based ATFCM restriction in FRA
Status	<In Progress>
Rationale	ATFCM restrictions based on route will be no more possible in free routing airspace. Airspace users need to be informed of volumes to be avoided for ATFCM purpose Further validation activities would be required to provide guidance on min/max size of volumes that would be usefully support this concept of volume-based ATFCM restrictions in FRA. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_018 of the Safety Assessment Report in section A.1.1 To be fully validated (at V3 level), large-scale real-time simulation or live trial would be required with volume-based ATFCM restrictions in the airspace (which has not been the case in the OFA03.01.03 validation exercises). It is recommended to complete the validation of this requirement (and more generally of the enhanced ATFCM processes required to manage air traffic flows and airspace capacity in FRA) within SESAR 2020.
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0510	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRFM.0115
Requirement	In Free Routing Airspace, impacts of User Preferred trajectories on possible flow measures in contingency plan shall be frequently reassessed
Title	Contingency plan assessment in FRA
Status	<Validated>
Rationale	Contingency plans are worked out in collaboration with appropriate partners and contain agreed catalogue of scenarios and possible flow measures. In order for the contingency plans to be effective in FRA, the impact of Free Routing operations on traffic flows has to be assessed on a regular basis.

	This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_019 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0530	<Full>

3.2.1.1.6 Functional safety requirements for Planning Separation Assurance

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0101
Requirement	In Free Routing Airspace, the Planning Controller shall be provided with procedures for ATSU/sector coordination of flights with unnamed Coordination Points
Title	Inter-sector coordination procedures adapted to FRA
Status	<Validated>
Rationale	Lack of named Coordination Points for user-defined routes across ATSU/sector boundaries (including at the border between neighbouring FRA volumes) to support seamless Free Routing operations. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_023 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0210	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0102
Requirement	In Free Routing Airspace, the LoA shall be adapted to accommodate Free Routing operations
Title	Letter Of Agreement in FRA
Status	<Validated>
Rationale	Today, acceptable handover conditions are often described with reference to the route structure and coordination point. In Free Routing Airspace, these conditions cannot be based on the route / published coordination point anymore. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_024 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance

<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0210	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0103
Requirement	In Free Routing Airspace, the Planning Controller shall be provided with tools to support coordination of flights across ATSU/sector boundaries with unnamed coordination points
Title	ATC coordination support tools adapted to FRA
Status	<Validated>
Rationale	In Free Routing Airspace, coordination of flights (data distribution, negotiation of entry/exit conditions) on user-defined routes across ATSU/sector boundaries outside named Coordination Points will need to be supported by the ATC systems in order to assist the ATCOs. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_025 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0211	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0104
Requirement	In Free Routing Airspace, any ATC procedure for ATSU/sector coordination shall be consistently applied by adjacent ATC service providers
Title	Consistent ATC coordination procedures in FRA
Status	<Validated>
Rationale	Consistent ATC coordination procedures permit seamless Free Routing operations and cross ACC boundary processing This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_023 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0214	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0105
Requirement	In Free Routing Airspace, the ATCOs (Planning Controller and Tactical Controller) shall be able to remove a flight of her/his sector from the ordered list of sectors that are expected to assume a given flight
Title	SKIP function in Free Routing Airspace
Status	<Validated>
Rationale	In Free Routing Airspace, the direct transfer of flights from the n-1 to the

	n+1 sector (SKIP function) will permit to mitigate short crossings of the sector on a case-by-case basis. Short sector crossings are more likely in Free Routing Airspace. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_027 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0217	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0106
Requirement	In Free Routing Airspace, the ATCOs (Planning Controller and Tactical Controller) shall be able to display the planned 2D trajectory of at least one selected flight
Title	Display of planned 2D trajectory in FRA
Status	<Validated>
Rationale	In Free Routing operations, the ATCOs cannot build her/his mental image of the situation based on the literal flight plans only. Moreover, in case of a long range route segment, the waypoints may be far from the sector, consequently out of the ATCO knowledge. A tool allowing the simultaneously display of the planned 2D trajectory of several selected flights might be an option to comply with these requirement but is not mandatory. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_028 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0240	<Full>
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0107
Requirement	In Free Routing Airspace of medium complexity or low complexity airspace with high traffic variability at sector/ATSU level, the Planning Controller shall be provided with trajectory-based Conflict Detection Tool for support the mid-term detection of encounters between flights
Title	Mid-term Conflict Detection support tool in FRA of medium complexity or low complexity with high traffic variability
Status	<Validated>
Rationale	In Free Routing Airspace, the PC needs a support to assess the global air situation including flights that follow an unfamiliar route scheme. Also conflicts may occur at border between two sectors and the PC needs a support to detect such conflicts in advance.

	A mid-term detection of encounters permits to predict potential loss of separation between two planned trajectories of interest for the sector (20 minutes time horizon as an order of magnitude). This functionality is considered as necessary in airspace of medium complexity or in airspace with high variability in traffic complexity. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_030 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0220	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0108
Requirement	In Free Routing Airspace, ATCOs (Planning controller and Tactical controller) shall be informed in due time of ARES activation status (active/not active/released) for ARES of relevance of the sector
Title	Information of ARES activation status in FRA
Status	<Validated>
Rationale	In Free Routing Airspace, ATCO need to be able to identify an active ARES that might have an impact on traffic to/from the sector (in order to propose a suitable coordination and avoid area infringement. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_026 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0220	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

3.2.1.1.7 Functional safety requirements for Tactical Separation Assurance

[REQ]

Identifier	REQ-04.07.02-SPR-FRTC.0101
Requirement	In Free Routing Airspace where Flight Plans may contain unnamed waypoints, the Tactical Controller shall be provided with an operational procedure to instruct vectoring flights to resume on their route
Title	Resume flights on their route in FRA
Status	<In Progress>
Rationale	As the next point may be unnamed and it is not possible to instruct by voice a flight to go toward a user-defined (LAT,LON) point, the TC cannot simply make a vectoring flight resuming its route. An ad hoc procedure is still an

	operational issue to be investigated and validated. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_034 of the Safety Assessment Report in section A.1.1 Procedures for how to clear back to the initially planned trajectory defined by LAT,LON points (and more generally for the revision of LAT,LON trajectories in FRA) would need to be further elaborated and validated within SESAR 2020 to find a harmonised solution.
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0233	<Full>

[REQ]

Identifier	REQ-04.07.02-SPR-FRTC.0102
Requirement	ATCO of sector before FRA shall be aware of FRA lower limit and strive to give clearances to make it possible for the aircraft to reach FRA lower level limit before the first point of their user-defined trajectory
Title	Training / familiarisation of the ATCO on FRA lower limit
Status	<Validated>
Rationale	Requirement relating to training of ATCO. If aircraft is not at the appropriate flight level (above FRA lower limit) when reaching the first point of its user defined trajectory, it will affect the ATCO activities (aircraft on a user defined route outside the Free Routing Airspace). A training / familiarisation of the ATCO of lower limit of the airspace is needed in order to avoid this kind of situation. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_040 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-07.02-DOD-0001.0002	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-FRTC.0103
Requirement	In Free Routing Airspace, FDPS database shall include all points of interest for the ATCO (e.g. all waypoints within the maximum length of the segments including points outside the ATSU area of responsibility)
Title	FDPS database in FRA
Status	<Validated>
Rationale	FDPS database needs to include some points of neighbouring area in order to avoid reception of flight plan with unknown points and consequently rejection of the flight plan. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_042 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>

Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-07.02-DOD-0001.0002	<Partial>
<ALLOCATED_TO>	<Functional block>	FPLD	N/A

3.2.1.1.8 Functional safety requirements for Ensuring Trajectory Adherence

[REQ]

Identifier	REQ-04.07.02-SPR-FRTA.0101
Requirement	In Free Routing Airspace, the ATCOs shall be supported by a MONA tool to monitor the flight adherence to the tactical trajectory
Title	Trajectory adherence monitoring in FRA
Status	<Validated>
Rationale	In Free Routing operations, the ATCOs can hardly monitor by themselves the route adherence of flights with an unfamiliar user-defined route. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_035 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0250	<Full>
<ALLOCATED_TO>	<Functional block>	MONA	N/A

3.2.1.1.9 Functional safety requirements for Ground-Based Safety Nets

[REQ]

Identifier	REQ-04.07.02-SPR-FRSN.0101
Requirement	In Free Routing Airspace, the ATCOs shall be assisted by a Short-Term Conflict Alert system
Title	Short-Term Conflict Alert (STCA) system in FRA
Status	<Validated>
Rationale	Controllers need system assistance to prevent collisions between aircraft when confronted with a multitude of ever different trajectories in FRA. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_036 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0810	<Full>
<ALLOCATED_TO>	<Functional block>	SNET	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRSN.0102
Requirement	In Free Routing Airspace, the ATCOs shall be assisted by an Area Proximity Warning system
Title	Area Proximity Warning (APW) system in Free Routing Airspace
Status	<Validated>
Rationale	Controllers need system assistance to be warned in short-term of unauthorised penetration of flights (e.g., controlled flights into restricted airspace or uncontrolled flights into controlled area) when confronted with a multitude of ever different trajectories and management of ARES in FRA. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_037 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0820	<Full>
<ALLOCATED TO>	<Functional block>	SNET	N/A

3.2.1.2 Integrity safety requirements (failure case)

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0301
Requirement	The frequency of occurrence of an aircraft in the free routing airspace on a user defined route (not part of ARN or DRA) outside FRA availability period shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft entering the free routing airspace on a user defined route outside FRA availability period
Status	<Validated>
Rationale	Two cases are possible for this hazard: • one aircraft arrive too early on a user defined route when the free routing airspace is not yet available • one aircraft still on a user defined route when free routing airspace is no more available Case of one aircraft should be manageable by ATCO without major impact on their workload. Cases of several aircraft on user defined route outside Free Routing Airspace availability period could have more impact (objective of limiting the free routing availability period is to ensure that the amount of traffic on user defined route will be manageable). A procedures for smooth transition between free routing and fixed route operations will be defined (see previous requirement in airspace management section) to limit the occurrence of this kind of hazard. This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_101 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0190	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0302
Requirement	The frequency of occurrence of an aircraft below FRA lower limit when reaching the point after which user defined trajectory is filed shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft below FRA lower limit when reaching the point after which user defined trajectory is filed
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_102 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0190	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0303
Requirement	The frequency of occurrence of an aircraft descending below FRA lower limit before reaching exit/arrival point shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft descending below FRA lower limit before reaching exit/arrival point
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_103 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0190	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0304
Requirement	The frequency of occurrence of an aircraft flying a segment longer than the maximum authorized length in the FRA shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft flying a segment longer than the maximum authorized length in the FRA
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_104 of the Safety Assessment Report in section A.1.1

Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0190	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0305
Requirement	The frequency of occurrence of an aircraft flying several segments shorter than the minimum authorized length in the FRA shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft flying several segments shorter than the minimum authorized length
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_105 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0190	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0306
Requirement	The frequency of occurrence of an aircraft flying a trajectory with user defined points (LAT/LON) whereas it is not allowed shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft flying a trajectory with user defined points (LAT/LON) in FRA whereas it is not allowed
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_106 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0190	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0307
Requirement	The frequency of occurrence of an aircraft entering the free routing airspace on a user defined route crossing an active ARES in FRA shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft entering the free routing

	airspace on a user defined route crossing an active ARES in FRA
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_107 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0190	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0308
Requirement	The frequency of occurrence of an aircraft flying a trajectory not compliant with ATFCM restrictions in FRA shall not be greater than 1.00E-03 per flight hour
Title	Maximum frequency of occurrence of an aircraft flying a trajectory not compliant with ATFCM restrictions in FRA
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_108 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0140	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0309
Requirement	The frequency of occurrence of loss of inter sector/ATSU coordination tool in FRA shall not be greater than 6.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of loss of inter sector/ATSU coordination tool compliant with ATFCM restrictions in FRA
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_109 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a medium complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0211	<Partial>

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0310
Requirement	The frequency of occurrence of loss of display of the planned trajectory in FRA shall not be greater than 2.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of loss of display of the planned 2D trajectory in FRA
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_110 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a medium complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0240	<Partial>
<ALLOCATED TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0311
Requirement	The frequency of occurrence of a discrepancy between ground and airborne trajectory in FRA shall not be greater than 2.00E-04 per sector operational hour
Title	Maximum frequency of occurrence of a discrepancy between ground and airborne trajectory in FRA
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_111 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a medium complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance

<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0240	<Partial>
<ALLOCATED_TO>	<Functional block>	TP&M	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0312
Requirement	The frequency of occurrence of loss of tactical trajectory adherence monitoring tool in FRA shall not be greater than 2.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of loss of route adherence monitoring tool in FRA
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_112 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a medium complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0250	<Partial>
<ALLOCATED TO>	<Functional block>	MONA	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0313
Requirement	The frequency of occurrence of loss of mid-term conflict detection tool in FRA shall not be greater than 2.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of loss of mid-term conflict detection tool in FRA
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_113 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a medium complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A

<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0220	<Partial>
<ALLOCATED TO>	<Functional block>	CONF	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0314
Requirement	The frequency of occurrence of an erroneous mid-term conflict detection in FRA (one conflict not detected by the tool) shall not be greater than 6.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of an erroneous mid-term conflict detection in FRA
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_114 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a medium complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0220	<Partial>
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0222	<Partial>
<ALLOCATED TO>	<Functional block>	CONF	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0315
Requirement	The frequency of occurrence of loss of tactical conflict detection tool when available in FRA shall not be greater than 2.00E-03 per flight hour
Title	Maximum frequency of occurrence of loss of tactical conflict detection tool in FRA
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_115 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a medium complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A

<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0220	<Partial>
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0222	<Partial>
<ALLOCATED_TO>	<Functional block>	CONF	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.0316
Requirement	The frequency of occurrence of an erroneous tactical conflict detection when available in FRA (one conflict not detected by the tool) shall not be greater than 6.00E-03 per sector operational hour
Title	Maximum frequency of occurrence of an erroneous tactical conflict detection in FRA
Status	<Validated>
Rationale	This requirement is derived from the hazard analysis of the Safety Assessment: see Safety Objective SO_FRA_116 of the Safety Assessment Report in section A.1.1. This safety objective has been converted from “per flight hour” to “per sector operational hour” considering the average number of flight hours flown within a medium complexity sector during one hour is of 6 flight hours controlled per sector hour (value used in ED-161). If a local implementation differs from this figure, a new conversion need to be performed based on the safety objective expressed per flight hour (see Safety Assessment Report for more details regarding the conversion).
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0230	<Partial>
<ALLOCATED TO>	<Functional block>	CONF	N/A

3.2.2 Performance Requirements

3.2.2.1 Operational Efficiency (including fuel efficiency)

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.1001
Requirement	Free Routing Operations shall be established such that Airspace User operational efficiency (i.e. in fuel efficiency and/or business/mission effectiveness) could be improved
Title	Flight efficiency improvement in Free Routing Airspace
Status	<Validated>
Rationale	Reduction in flight plan route distance can have direct positive impact on - Fuel Efficiency, through the reduction of flight time and distance. - Business/mission effectiveness, through planning and execution of flights closer to AUs needs This can also have direct positive impact on Environment, through fuel burnt and emissions reduction.
Category	<Performance>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0101	<Full>

<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.1002
Requirement	Wherever possible taking into account airspace and demand complexity, Free Routing Operations shall be established such that for any two waypoints the plannable flight plan route distance in an unrestricted Free Routing Airspace is not longer than the great circle distance
Title	Maximum length of flight plan distance in FRA
Status	<Validated>
Rationale	In unrestricted Free Routing Airspace, Airspace Users will be able to plan flights along user-defined segments being portions of Great Circles from entry to exit of FRA. Consequently, a FRA with a maximum segment length lower than the size of the airspace would not be "an unrestricted FRA". Similarly, a FRA with ATFCM restrictions put in place for safety / capacity purposes would not be “an unrestricted FRA". Wherever it is possible for AUs to plan flights direct from entry to exit to FRA, this will have a direct positive impact on Fuel Efficiency, through the reduction of flight time and distance.
Category	<Performance>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0101	<Partial>
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.1003
Requirement	Free Routing Operations shall be established such that the flight plan route distance in a Free Routing Airspace is not be longer than the great circle distance + X% independent from the number of active Airspace Reservations, when tactical rerouting is provided
Title	Maximum length of flight plan distance in case of tactical rerouting in FRA
Status	<Validated>
Rationale	The ability of Airspace Users to plan flights along user-defined segments as close as possible to the great circle distance from entry to exit of FRA will have a direct positive impact on: - Fuel Efficiency, through the reduction of flight time and distance.
Category	<Performance>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0101	<Full>
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A

3.2.2.1.1.1 Capacity

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.1004
Requirement	In permanently low to medium complexity environments, Free Routing Operations shall not compromise Airspace Capacity
Title	Non negative impact on Capacity in FRA of permanently low to medium complexity
Status	<Validated>

Rationale	The current ATM system cannot afford a loss of capacity due to Free Routing operations. Within Free Routing Airspace, traffic will not enter or leave the sector at specific COPs, and conflicts could appear anywhere within the sector as a result of removing predefined crossing points existing in the ARN. This might increase the complexity at sector/ATSU level particularly in case of Free Routing operations across ACC/FIR borders. ATC will need to be supported by appropriate procedures and tools so as to not negatively impact airspace capacity.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0401	<Full>
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.1006
Requirement	In environments with high variability in traffic complexity at sector/ATSU level, Free Routing Operations shall not compromise Airspace Capacity
Title	Non negative impact on Capacity in FRA with high variability in traffic complexity
Status	<In Progress>
Rationale	The current ATM system cannot afford a loss of capacity due to Free Routing operations. Within Free Routing Airspace, trajectories will vary from day to day, and not follow a specific pattern, which might increase the complexity at sector/ATSU level particularly in case of Free Routing operations across ACC/FIR borders; but this might also lead to improvements for ATCOs as several aircraft can be kept in the same flight level as they are spread over a wider area assuming that no major flow convergence phenomena would remain after adequate ATFCM. ATC will also need to be supported by appropriate procedures and tools so as to not negatively impact airspace capacity. Validation results (from EXE-04.03-VP-797) have shown that Free Route operations can result in high variability in traffic complexity at sector/ATSU with a convergence phenomenon of traffic flows leading to a number of interactions and conflicts expected to be very high and really difficult to manage by ATCOs. It is recommended to complete the validation of this requirement within SESAR 2020.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0401	<Full>
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

3.2.2.1.1.2 Predictability

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.1005
Requirement	In permanently low to medium complexity environments, Free Routing Operations shall not adversely impact ATFCM delays
Title	Non negative impact on Predictability in FRA of permanently low to medium complexity
Status	<Validated>
Rationale	The current ATM system cannot afford an increase of ATFCM delays due to Free Routing operations.
Category	<Performance>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-PRD1.0010	<Full>
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FR00.1007
Requirement	In environments with high variability in traffic complexity at sector/ATSU level, Free Routing Operations shall not adversely impact ATFCM delays
Title	Non negative impact on Predictability in FRA with high variability in traffic complexity
Status	<In Progress>
Rationale	The current ATM system cannot afford an increase of ATFCM delays due to Free Routing operations. Within Free Routing Airspace, trajectories will vary from day to day, and not follow a specific pattern. Major flow convergence phenomena and new hotspots might be observed, which might increase the number of regulated flights and en-route delays per flights. Adequate FRA design and configuration adapted to traffic demand will need to be established, as well as if required ATFCM constraints on trajectories, so as to not negatively impact ATFCM delays. Validation results (from EXE-04.03-VP-797) have shown that Free Route operations can result in high variability in traffic complexity at sector/ATSU with hotspots that might increase the number of regulated flights and ATFCM En-Route delay per delayed flights. It is recommended to complete the validation of this requirement (and more generally of the enhanced ATFCM processes required to manage air traffic flows and airspace capacity in FRA) within SESAR 2020.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-PRD1.0010	<Full>
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

3.2.2.2 Performance requirements for BT/MT Flight Planning

3.2.2.2.1 Operational Efficiency (including fuel efficiency)

[REQ]

Identifier	REQ-04.07.02-SPR-FRFP.1001

Requirement	After any change to the Free Routing Airspace properties, Airspace Users shall evaluate the impact of the change sufficiently fast to be able to re-plan the trajectory if deemed beneficial in terms of flight cost efficiency/fuel efficiency.
Title	Flight re-planning by AU after change to the FRA properties
Status	<In Progress>
Rationale	The ability of the Airspace Users to re-plan flights after any change in FRA properties (in terms of time, volume availability or any other features) can have a positive impact on: - Fuel Efficiency, through the reduction of flight time and distance. - Business/mission effectiveness, through planning and execution of flights closer to AUs needs. To be fully validated (at V3 level), large-scale real-time simulation or live trial involving all actors would be required (which has not been the case in the OFA03.01.03 validation exercises). It is recommended to complete the validation of this requirement (and more generally of the enhanced ATFCM processes required to manage air traffic flows and airspace capacity in FRA) within SESAR 2020.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0101	<Full>
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<ALLOCATED_TO>	<Functional block>	Decision Support Management	N/A

3.2.2.2.2 Predictability

[REQ]

Identifier	REQ-04.07.02-SPR-FRFP.1002
Requirement	In Free Routing Airspace, Airspace Users shall be allowed to use any available Intermediate point (published or user-defined) to avoid active ARES in the flight planning phase
Title	Flight planning around active ARES in FRA
Status	<Validated>
Rationale	To plan flights outside active ARES in FRA, Airspace Users will use any available Intermediate points that can be either published points or user-defined points if allowed in the airspace. Published points should provide predictability for airspace users when Free Routing Operations are not available in certain areas of the airspace. These points shall allow correct flight plan data to be integrated and distributed throughout the system.
Category	<Performance>
Validation Method	<Live Trial>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0120	<Full>
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<ALLOCATED_TO>	<Functional block>	Flight Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRFP.1003
Requirement	In Free Routing Airspace of permanently low to medium complexity, flight

	planning of trajectories by Airspace Users through Airspace Reservations, when tactical re-routing is provided, shall be allowed
Title	Flight planning of trajectories through Airspace Reservations with tactical re-routing in FRA
Status	<Validated>
Rationale	Where possible taking into account airspace and demand complexity, ARES with tactical re-routing (by ATCOs during the execution phase) could be defined in FRA. This possibility for tactical re-routing in FRA has to be published in relation to the ARES. It will allow Airspace Users to plan optimised trajectories combining any of the published entry/exit waypoints within a Free Routing Airspace when capacity is not constrained.
Category	<Performance>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR11.0130	<Full>
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<ALLOCATED_TO>	<Functional block>	Flight Management	N/A

3.2.2.3 Performance requirements for Airspace Management

3.2.2.3.1 Capacity

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.1001
Requirement	The setting of the lower limit of Free Routing Airspace shall not adversely impact capacity of any adjacent/subjacent non-FRA volume
Title	No capacity impact from lower limit of FRA
Status	<In Progress>
Rationale	Free Routing Airspace has to facilitate transition to and from non-FRA airspace. The parameters to be taken into account to facilitate this transition include: traffic flows, complexity of traffic, sector capacity in FRA (and non-FRA) airspace. To be fully validated (at V3 level), large-scale real-time simulation or live trial involving all actors would be required (which has not been the case in the OFA03.01.03 validation exercises). It is recommended to complete the validation of this requirement (and more generally of the enhanced ATFCM processes required to manage air traffic flows and airspace capacity in FRA) within SESAR 2020.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0120	<Full>
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

3.2.2.3.2 Operational Efficiency (including fuel efficiency)

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.1002
Requirement	The common lower level of Free Routing Airspace shall be the lowest possible taking into account airspace and demand complexity across Europe (with the possibility of lower local level wherever possible)

Title	Harmonisation of lowest level of Free Routing Airspace
Status	<Validated>
Rationale	A Free Routing Airspace has to facilitate transition to and from non-FRA airspace. The volume of Free Routing Airspace has to be as large as possible in order to have benefits for: - Environment, through fuel burnt and emissions reduction, - Time & Fuel Efficiency, through the reduction of flight time.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0121	<Full>
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.1003
Requirement	The horizontal limits of Free Routing Airspace shall be as large as possible taking into account airspace and demand complexity across Europe
Title	Harmonisation of horizontal limits of Free Routing Airspace
Status	<Validated>
Rationale	The harmonisation of horizontal airspace structure which allows cross-border Free Routing operations is needed throughout Europe. Crossing of lateral boundaries of neighbouring FRA volumes should impact the flight planning to a minimal extent.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0122	<Full>
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRAM.1004
Requirement	In case of adjacent Free Routing Airspaces, the usage of cross border Free Routing Operations shall be allowed without mandatory Coordination Points to be overflown
Title	Free Routing Operation across borders
Status	<Validated>
Rationale	Cross border Free Routing Operations need to be allowed in order to provide optimal trajectories to Airspace Users
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0131	<Full>
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

3.2.2.4 Performance requirements for ATFCM (Dynamically Balance Network Capacity with Demand)

3.2.2.4.1 Capacity

[REQ]

Identifier	REQ-04.07.02-SPR-FRFM.1001
Requirement	In Free Routing Airspace, the Airspace Users shall update the flight plan information with the required flight plan adjustment at the STAM measure implementation time
Title	Flight plan update other than departure delay for non-ATC activated flights in Free Routing Airspace
Status	<In Progress>
Rationale	STAM DCB implementation in FRA is based on existing processes and services supporting the planning and execution of flights. Timely update of Flight Plan Information will allow more accurate demand prediction using the most up to date trajectory information. To be fully validated (at V3 level), large-scale real-time simulation or live trial involving all actors would be required (which has not been the case in the OFA03.01.03 validation exercises). It is recommended to complete the validation of this requirement (and more generally of the enhanced ATFCM processes required to manage air traffic flows and airspace capacity in FRA) within SESAR 2020.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0673	<Full>
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<ALLOCATED_TO>	<Functional block>	Flight Management	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRFM.1002
Requirement	In Free Routing Airspace, Complexity Assessment tools shall be trajectory-based
Title	Complexity Assessment in Free Routing Airspace
Status	<In Progress>
Rationale	In Free Routing Airspace, the traffic flows will be less structured and conflicts could appear anywhere as a result of removing predefined crossing points existing in the ARN. This is needs to be taken into account when assessing the complexity within the airspace. To be fully validated (at V3 level), large-scale real-time simulation or live trial involving all actors would be required (which has not been the case in the OFA03.01.03 validation exercises). It is recommended to complete the validation of this requirement (and more generally of the enhanced ATFCM processes required to manage air traffic flows and airspace capacity in FRA) within SESAR 2020.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR07.0680	<Full>

<ALLOCATED_TO>	<Functional block>	LTCM	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

3.2.2.5 Performance requirements for Planning Separation Assurance

3.2.2.5.1 System Performance

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.1001
Requirement	In Free Routing Airspace, flight data distribution shall be possible across ATSU/sector boundaries with unnamed Coordination Points
Title	Flight Data distribution at ATS level in FRA
Status	<Validated>
Rationale	Coordination of flights in Free Routing across ATSU/sector boundaries outside named Coordination Points will need to be supported by the ATC Flight Data Processing and Distribution systems.
Category	<Performance>
Validation Method	<Live Trial>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0211	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	FPLD	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.1002
Requirement	In Free Routing Airspace, flights entering the sector/ATSU shall be displayed on the CWP HMI early enough to manage potential conflicts at or close to sector boundaries
Title	Display of flights in AoI of the sector/ATSU on CWP in FRA
Status	<Validated>
Rationale	To manage flights in Free Routing Airspace, the PC needs be able to detect mid-term encounters as soon as possible prior to the entry into the sector.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-HMI.0001	<Full>
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.1003
Requirement	In Free Routing Airspace where long route segments may be planned, the CD/R aid shall consider that user-defined segments are portions of Great Circles
Title	Trajectory Prediction using Great Circles in FRA
Status	<Validated>
Rationale	There may be a several miles gap between the Great Circle and the linear segment between two distant points, which is not acceptable for Separation

	purpose For information: in the current fixed route network, the route segments are short enough to be modelled as straight lines.
Category	<Performance>
Validation Method	<Live Trial>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0223	<Full>
<ALLOCATED_TO>	<Functional block>	TP&M	N/A
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	MONA	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.1005
Requirement	When available in Free Routing Airspace, the Conflict Detection Tool for PC shall support the mid-term detection of encounters between flights in a permanent and continuous way
Title	Continuity of Mid-term Conflict Detection support tool in FRA
Status	<Validated>
Rationale	To manage Free Routing operations, the Conflict Detection Tool for PC can be essential to support the mid-term detection of encounters. To be efficient, the tool needs to detect mid-term encounters in a permanent and continuous way.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED- FR04.0220	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.1006
Requirement	When available in Free Routing Airspace, the Conflict Detection Tool for PC shall perform mid-term detection of encounters between flights as soon as the flights are distributed (and not necessarily assumed) in the sector
Title	Timeliness of Mid-term Conflict Detection support tool in FRA
Status	<Validated>
Rationale	To manage Free Routing operations, the Conflict Detection Tool for PC can be essential to support the mid-term detection of encounters. To be efficient, the tool needs to detect mid-term encounters as soon as possible prior to the entry into the sector.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0225	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.1007
Requirement	In Free Routing Airspace, the mid-term encounters detected by Conflict Detection Tool for PC shall be displayed in a way that makes the analysis of the conflict geometry understandable for ATCOs
Title	Display of mid-term encounters detected by Conflict Detection tool in FRA
Status	<Validated>
Rationale	To manage Free Routing operations, the Conflict Detection Tool for PC is essential to support the mid-term detection of encounters. To be efficient, the display of mid-term encounters detected by the tool needs to help to PC to easily understand the conflict geometry.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0001.0023	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.1008
Requirement	In Free Routing Airspace, ATC coordination tools shall support the negotiation of entry/exit conditions at sector level outside ATS routes and with unnamed coordination points
Title	Support tool for negotiation of entry/exit conditions in FRA
Status	<Validated>
Rationale	Coordination of flights in Free Routing across ATSU/sector boundaries outside named Coordination Points will need to be supported by the ATC systems in order to negotiate entry/exit conditions at sector level.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-07.02-DOD-0001.0002	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.1009
Requirement	In Free Routing Airspace, the display of planned 2D trajectory of a selected flight shall be possible via direct access on the CWP HMI
Title	Easy display of selected planned 2D trajectory in FRA
Status	<Validated>
Rationale	In Free Routing Airspace, a tool allowing the display of the planned 2D trajectory of at least one selected flight is essential for ATCOs to build her/his mental image of the situation. To be efficient, the access to the display the selected trajectory needs to be direct.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0240	<Full>
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.1010
Requirement	In Free Routing Airspace, the display of planned 2D trajectory of a selected flight shall be instantaneous
Title	Prompt display of selected planned 2D trajectory in FRA
Status	<Validated>
Rationale	In Free Routing Airspace, a tool allowing the display of the planned 2D trajectory of at least one selected flight is essential for ATCOs to build her/his mental image of the situation. To be efficient, the tool needs to display the selected trajectory without delay.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0240	<Full>
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

3.2.2.6 Performance requirements for Tactical Separation Assurance

3.2.2.6.1 Human Performance

[REQ]

Identifier	REQ-04.07.02-SPR-FRTC.1001
Requirement	In Free Routing Airspace, the ATCOs (Planning Controller and Tactical Controller) shall be provided with a tool to determine the minimum distance between two selected flights based on the current state vectors
Title	Tool for determination of the minimum distance between two selected flights in FRA
Status	<Validated>
Rationale	With no classical route scheme, the ATCO needs a support to analyse the air situation and notably the potential loss of separation based on the current state vectors.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-HMI.0001	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRTC.1002
Requirement	In Free Routing Airspace, the ATCOs (the Planning Controller and the Tactical Controller) shall be provided with support tool to visualise alternative trajectory in case of Direct to a next waypoint by means of a CWP HMI function
Title	Visualisation on CWP of alternative trajectory in case of direct flight in FRA
Status	<Validated>
Rationale	Traffic situational awareness in Free Routing Airspace requires any route update to be visually considered by the ATCO.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED- FR04.0234	<Full>
<ALLOCATED_TO>	<Functional block>	TP&M	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

3.2.2.6.2 System Performance

[REQ]

Identifier	REQ-04.07.02-SPR-FRTC.1003
Requirement	When available in Free Routing Airspace, the Conflict Detection Tool for TC shall perform detection of tactical encounters involving at least one eligible flight
Title	Eligibility for detection of tactical encounters by TCT in FRA
Status	<Validated>
Rationale	Eligible flights for Tactical Conflict Detection tool are to be determined taking into account the relevant local factors and procedures, e.g. flights released by the upstream sector, assumed flights or flights released and not yet assumed to the down-stream sector.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0230	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRTC.1004
Requirement	When available in Free Routing Airspace, the Conflict Detection Tool for TC shall detect tactical encounters between two flights within a predefined time horizon of at least X minutes up to Y minutes
Title	Time horizon of Tactical Conflict Detection support tool in FRA
Status	<Validated>
Rationale	In Free Routing Airspace, the TC would need a support to assess tactical situations involving flights that do not follow any familiar route scheme. A detection of tactical encounters permits to predict potential loss of separation between two tactical trajectories within a maximum time horizon (typically 8 minutes as an order of magnitude). A minimum time horizon (at least 4mn as an order of magnitude) is also

	needed for the TC to assess the air situation and take appropriate action if necessary to maintain separation between flights. To accommodate local relevant factors, this time horizon parameter should be locally configurable and assessed according to the sector design.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0230	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRTC.1005
Requirement	In Free Routing Airspace, the display of alternative trajectory shall be possible in case of Direct to a next waypoint even outside sector / ATSU area of responsibility
Title	Display of alternative trajectory in case of Direct in FRA
Status	<Validated>
Rationale	Traffic situational awareness in Free Routing Airspace requires any route update to be visually considered by the ATCO.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0234	<Full>
<ALLOCATED_TO>	<Functional block>	TP&M	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRTC.1006
Requirement	In Free Routing Airspace, the display of alternative trajectory shall be clearly distinguished from that of actual trajectory
Title	Display of alternative trajectory and actual trajectory in FRA
Status	<Validated>
Rationale	Traffic situational awareness in Free Routing Airspace requires any route update to be visually considered by the ATCO.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0234	<Full>
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A

3.2.2.7 Performance requirements for Ensuring Trajectory Adherence

3.2.2.7.1 System performance

[REQ]

Identifier	REQ-04.07.02-SPR-FRTA.1002
Requirement	In Free Routing Airspace, the MONA shall permanently and continuously check the flight adherence to the tactical trajectory
Title	Continuity of MONA tool for trajectory adherence monitoring in FRA
Status	<Validated>
Rationale	Need for MONA to support TC monitoring of route adherence for FRA of flights both in cruise and vertically evolving across ACC/FIR boundaries
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0250	<Full>
<ALLOCATED_TO>	<Functional block>	MONA	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

3.3 Information Exchange Requirements (IER)

No new Information Elements exchanged by actors within ATM have been identified in support to Free Route operations, which would be neither in the AIRM nor in an external / standard source document.

4 References and Applicable Documents

This section identifies the documents (name, reference, source project) the SPR has to comply to or to be used as additional inputs for the SPR.

4.1 Applicable Documents

This SPR complies with the requirements set out in the following documents:

[1] Template Toolbox 03.00.00
https://extranet.sesarju.eu/Programme%20Library/SESAR%20Template%20Toolbox.dot

[2] Requirements and V&V Guidelines 03.00.00
https://extranet.sesarju.eu/Programme%20Library/Requirements%20and%20VV%20Guidelines.doc

[3] Templates and Toolbox User Manual 03.00.00
https://extranet.sesarju.eu/Programme%20Library/Templates%20and%20Toolbox%20User%20Manual.doc

[4] EUROCONTROL ATM Lexicon
https://extranet.eurocontrol.int/http://atmlexicon.eurocontrol.int/en/index.php/SESAR

4.2 Reference Documents

The following documents were used to provide input / guidance / further information / other:

[5] B4.1 Updated Step 1 Validation Targets - Aligned with Data Set 13, Ed. 00.01.00

[6] B4.1 European ATM Master Plan Edition 2 - The Roadmap for Sustainable Air Traffic Management

[7] B4.2 SESAR Concept of Operations Step 1 Final Edition, Ed. 02.02.00

[8] C02-D2 Performance Plan (pan-European regional and national) for ATM-MP Ed. 3, Edition 01.00.03

[9] ED-133 Flight Object Interoperability Specification, June 2009[10]

[10] EUROCONTROL ERNIP, Part 1, European Airspace Design Methodology Guidelines - General principles and technical specifications for airspace design, Edition 1.6, June 2016

[11] EUROCONTROL ERNIP, Part 2, European ATS Route Network – Version 2015/2018-19, Edition June 2015

[12] EUROCONTROL Network Operations Portal (NOP) - Route Availability Document (RAD) http://www.nm.eurocontrol.int/RAD/index.html

[13] EUROCONTROL Performance Review Report 2013, An Assessment of Air traffic Management in Europe during the Calendar Year 2013, May 2014

[14] EUROCONTROL STATFOR Medium term forecast, February 2015

[15] ICAO Document 9854 Global Air Traffic Management Operational Concept

[16] ICAO Document 9613 Performance Based Navigation (PBN) Manual, Edition 4

[17] ICAO Document 4444 PANS-ATM

[18] ATM Master Plan, Data Set 16, 31 May 2016

[19] SESAR European ATM Architecture (EATMA) V7.0
https://www.eatmportal.eu/working/data/services

[10] This draft version of the Flight Object Interoperability Specification published by EUROCAE will be adapted to fit in the overall concept taking into account the results of the SESAR validation activities.

[20] SESAR The European ATM Master Plan, Edition 2015
http://ec.europa.eu/transport/modes/air/sesar/doc/eu-atm-master-plan-2015.pdf

[21] SESAR Safety Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[22] SESAR Security Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[23] SESAR Environment Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[24] SESAR Human Performance Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[25] SESAR Business Case Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[26] SJU Free Route Task Force final report, Edition 00.01.00
https://extranet.sesarju.eu/releasehome/OFA03.01.03/Working%20Library/Free%20Route%20Task%20Force/Free%20Route%20Task%20Force%20Conclusions%20V00.01.00.doc

[27] 01.09-D2 WE-FREE Demonstration Report, Edition 00.00.06, May 2014

[28] 02.01-D12 FRAMaK – Final Project Report (Demonstration Report), Edition 00.02.03, July 2014

[29] LSD.01.05-D3 FREE SOLUTIONS Demonstration Report, Edition 00.03.03, July 2016

[30] 04.03-M602 Validation Report of EXE-04.03-VP-797, Edition 00.01.00, September 2016

[31] 04.03-M603 Validation Report of EXE-04.03-VP-798, Edition 00.01.00, September 2016

[32] 04.07.02-D28 OSED_4, Edition 00.01.00, August 2016

[33] 04.07.02-D37 Free Route Operational Service and Environment Definition (OSED) for Step 1 - Iteration 2, Edition 00.02.01, January 2015

[34] 07.05.03-D35 Validation Report for Step 1 User Preferred Routing, Edition 00.02.00, December 2013

[35] 11.01.05-D23 Contribution to EXE-04.03-VP-797- Free Route Step 1 V2 Validation Report, Edition 00.01.00, August 2016

Appendix A Assessment / Justifications

A.1 Safety and Performance Assessments

A.1.1 Safety assessment

The following file presents the Safety assessment preformed for the Free Route OFA. It addresses both Direct Routing in high complexity environment and Free Routing in low to medium complexity environment concepts.

This assessment was conducted according to the SESAR Safety Reference Material [21]. This assessment was conducted up to OSED level. The Safety Objectives (i.e. safety requirements at OSED level) of this document have been reviewed and updated based on the outcomes from the V2 and V3 Free Route validation exercises.

Free Routing Safety Assessment Report -

Safety requirements and recommendations presented respectively in sections 3 and A.2 are derived from this Safety Assessment Report.

A.1.2 Security risk assessment

Due to the transversal nature of the Free Route operational concept which deals with whole ATM system (ranging from AU, NM and En-Route ATS operations from the planning to the execution phase), no specific Security Risk Assessment has been performed in the context of the OFA03.01.03.

A.1.3 Environment impact assessment

In this section have been reported a summary of results and the links to Environmental Impact assessment performed in the context of Validation Exercises of the OFA validation path).

Hereafter is the summary of the results collected for the following validation exercises: EXE-07.05.03-VP-465, EXE-07.05.03-VP-571, FRAMAK, WE-FREE, EXE-04.03-VP-797 and FREE SOLUTIONS.

Validation Exercise	Success Criterion	Results (fuel Burn and Emissions)
EXE-07.05.03-VP-465	Analysis of Fuel savings and emissions	- The average fuel saving per UPR FPL (total flight) was 0.11% (Iceland Air), 0.17% (SAS) and 0.21% (Emirates) compared to non UPR FPLs in VP-465. - Results are affected by close to optimal non UPR FPLs. SAS used the Swedish FRA initiative and Iceland Air had short haul flights between a main departure-destination pair resulting in reducing saving from UPR. - Results show the concept produced an average fuel saving for participating airlines hence emissions produced would be reduced by a proportional amount (between 0.11% and 0.21%).

Validation Exercise	Success Criterion	Results (fuel Burn and Emissions)
EXE-07.05.03-VP-571	Analysis of Fuel savings and emissions	- Fuel burn reduced by 6-12% when using DCT routings instead of the fixed ATS route network within MUAC airspace depending on scenario and sector group. - Average reduction in emissions ranged from 6% to 12% within MUAC when using DCTs instead of the fixed ATS route network depending on the scenario and the sector group.
FRAMAK	Reduction of CO2 emission in Cross-Border DCT operations	Based on FPL routings CO2 emissions decreased by 339.8 kg (-0.8%) per flight (weekend traffic: -458.5 kg / -1.1%). Based on actual flown routes CO2 emissions decreased by 178.1 kg (-0.4%) per flight (weekend: -301.0 kg / 0.7%).
FRAMAK	Reduction of Nox emission in Cross-Border DCT operations	Based on FPL routings NOx emissions decreased by 2.9 kg (-1.3%) per flight (weekend traffic: -3.1 kg / -1.3%). Based on actual flown routes NOx emissions decreased by 1.2 kg (-0.5%) per flight (weekend: -1.9 kg / -0.8%
FRAMAK	Reduction of CO2 emission in Cross-Border DCT operations	Potential reduction by 30,243,252 kg CO2per year (weekend: 13,301,912 kg per year). Average reduction by 83 kg (weekend: 110 kg) CO2 per flight.
FRAMAK	Reduction of CO2 emission in Cross-Border DCT operations	Reduction of CO2 emission per day: by 76,433 kg (152 kg per flight) for H24 DCTs (Scen_1), by 112,730 kg (145 kg per flight) for WE DCTs (Scen_1a) by 120,482 kg (137 kg per flight) for WE DCTs (Scen_3a) by 222,570 kg (166 kg per flight) for FRA 365
FRAMAK	Reduction of NOx emission in Cross-Border DCT operations	Reduction of NOx emission per day: by 336.2 kg (0.67 kg per flight) for H24 DCTs (Scen_1), by 524.5 kg (0.67 kg per flight) for WE DCTs (Scen_1a) by 571.3 kg (0.65 kg per flight) for WE DCTs (Scen_3a) by 831.9 kg (0.62 kg per flight) for FRA 365+
WE-FREE	Analysis of Fuel savings based on: • Planned Horizontal route length • Planned Higher Flight level • Planned Trip Fuel	WE FREE routes saved an average 6 tons of Fuel per day corresponding to~ 20 tons of CO2 reduction per day). OKEPI MOKIP [11]use brought 3,5 tons of Fuel savings per day of trial and so 10 tons of CO2 emission reduction per day.

[11] We-Free Route

Validation Exercise	Success Criterion	Results (fuel Burn and Emissions)
EXE-04.03-VP-797 FOC assessment	Analysis of Fuel savings	Depending on the detailed Free Route environment, average fuel savings of up to 2.53% were achieved.
FREE SOLUTIONS	Efficiency: Positive impact on fuel saving and CO2	Overall Fuel Burn saved (for 1,002 flight trials): 34,574Kg Overall CO2 Emission saved (for 1,002 flight trials): 109,212 Overall NOX Emission Saved (for 1,002 flight trials): 894

For further details, below are the links to Environmental Impact assessment performed in the context of Validation Exercises of the OFA validation path:

- EXE-07.05.03-VP-465: Validation Report [34], section 6.1.3.1.2.3

  https://extranet.sesarju.eu/WP_07/Project_07.05.03/Project%20Plan/Step%201/Validation%20Report/07.05.03-D35-Step%201%20VALR.doc

- EXE-07.05.03-VP-571: Validation Report [34], section 6.2.3.1.1.1.3

  https://extranet.sesarju.eu/WP_07/Project_07.05.03/Project%20Plan/Step%201/Validation%20Report/07.05.03-D35-Step%201%20VALR.doc

- FRAMAK: Demonstration Report [28], section 6

  https://extranet.sesarju.eu/demoprojects/Project_02.01/Project%20Plan/D12%20FRAMaK%20Final%20Report%2000%2002%2003.pdf

- WE-FREE: Demonstration Report [27], Appendix A.1

  https://extranet.sesarju.eu/demoprojects/Project_01.09/Project%20Plan/20140520%20WE%20FREE%20Final%20report%2000.00.06.docx

- FREE SOLUTIONS: Demonstration Report [29], sections: 4.1.2, 6.1.3.1.1, 6.3.3.1.1, 6.4.3.1.1.1, 6.5.3.1.1.1

  https://extranet.sesarju.eu/LSD/LSD.01.05/Project%20Plan/Deliverables/LSD.01.05-D03-Demonstration%20Report.docx

- EXE-04.03-VP-797: WP11.1 (Lufthansa Systems) contribution to the VP797 Validation Report [35], sections 4.1.2 and 4.2

  https://extranet.sesarju.eu/WP_11FW/Project_11.01.05/Project%20Plan/FR%20(Free%20Route)/11.01.05-D23-Contribution%20to%20EXE-04.03-VP-797%20Free%20Route%20Step%201%20V2%20Validation%20Report%20LSY.doc

A.1.4 OPA

A.1.4.1 OPA Methodology for SPR

The performance assessment process, shown in B05 Performance Assessment Methodology for Step1 SESAR timeframe Figure 9 is divided into four main phases, which are performance framework definition, qualitative assessment, quantitative assessment, and analysis. In details the four steps are as follows.

- For the **performance framework definition** the scope is defined first, which means selecting the KPAs, Key Performance Indicators (KPIs) and Influencing Factors (IFs) considered in the performance assessment. Based on the selected KPAs, Influence Diagrams have to be developed, chosen from previous work, or obtained from WP B4.1.
- The **qualitative assessment** contains two subparts. At first, an assessment of the impact of individual Operational Improvements (OI) steps on influencing factors has to be made by means of defining benefits mechanisms, followed by a qualitative aggregation of OI steps' benefits to influencing factors.
- For the **quantitative assessment**, first quantitative models have to be established from qualitative ones. Then, the quantitative evidence has to be collected from validation experiments, or estimated with help of expert groups. Finally, the quantitative benefits are aggregated to the KPA level.
- The **analysis** starts with a maturity assessment, which is collecting additional information for passing the transition criteria of the V3 validation phase. The subsequent gap analysis is limited to a subset KPAs and KPIs for which draft targets are defined by B4.1 [5]. The analysis phase finishes with conclusions drawing and recommendations provision.

Bearing in mind this classification, the technique proposed for this SPR covers aspects of this B05 performance process. In the context of this project has been set a methodology that, following the B05 idea, performs the performance assessment based on contents coming from project Benefit Mechanism, OSED and Validation Reports of various exercises and joined from expert people internal to the project.

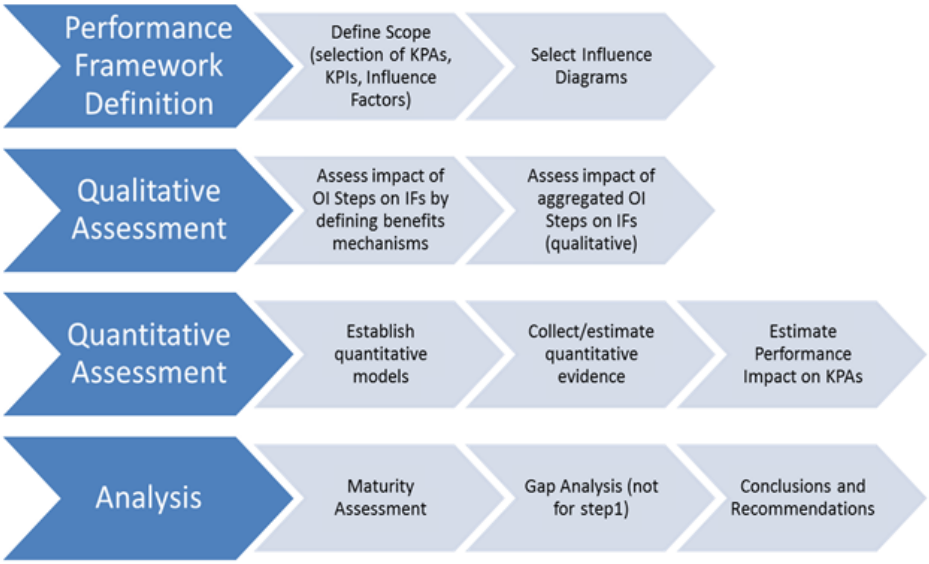

Figure 9: B05 performance assessment process

As shown in Figure 9, the **Operational Performance Assessment** (OPA) proposed for this SPR follows transversally the B05 OPA Process supported by a simple and schematic approach to obtain performance requirements that should mitigate/prevent some operational issues impacting the key performance area under assessment.

The methodology presented can be considered as simple tool that guide the users to look at the link between KPA and Performance Requirements. As input, it considers concept description of OSED (Operational Service and Environment description), exercise Validation Reports (VALRs) and benefit mechanism documents produced at project level. As output, it proposes a mapping for each of KPA assessed the link between the KPI addressed and the Performance Requirements developed.

The following table shows the structure of this mapping:

KPI Assessed	Related Validation exercise	Results	Link to Performance Requirements

As the SPR template mentions, the OPA has to refer to any Operational Performance other than Safety, Security and Environment that have been addressed into others dedicated sections of the document. In this regard, the performance assessment methodology proposed here for SPR provides the traceability with Performance Requirements (PRs) for performance areas not already investigated.

Therefore, the Key Performance Indicators have been classified into these four different KPAs:

- Capacity
- Operational Efficiency
- Predictability
- Human Performance

According to SPR template guidelines, this section should present also the links with **Human Performance assessments** and provide references to any results that may exist in order to support and provide traceability to any Human Performance related requirements listed in Chapter 3.

A.1.4.2 Capacity

A summary of key validation results and linked performance requirements related to Capacity is provided hereafter.

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
Traffic complexity/ potential conflict management	WE-FREE	No impact on capacity	REQ-04.07.02-SPR-DRAM.1005 REQ-04.07.02-SPR-DRFM.1001

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
Number of potential conflicts	EXE-07.05.03-VP-571	- For two sector groups there was an increase in conflict complexity (except one sector in the night / near night / weekend scenario) however ATCOs stated it would not impact capacity. - The third sector group had an increase in potential conflicts and complexity in situations of high traffic density. In such a scenario capacity would be impacted and alternative airspace solutions would need to be considered.	REQ-04.07.02-SPR-DRAM.1005 REQ-04.07.02-SPR-DRFM.1001
Number of flights in Cross Border DCT operations	FRAMAK	- No negative effects (at NM level) - Number of movements remains on a comparable level in cross border DCT operations. - Subjective feedback from ATCO was to require a capacity reduction like done for thunderstorms in certain sectors.	REQ-04.07.02-SPR-DRAM.1005 REQ-04.07.02-SPR-DRFM.1001
ENR Throughput in Cross Border DCT operations	FRAMAK	- No negative effects (at NM level) - The occupancy of each sector (maximum number of simultaneously controlled aircraft) is not negatively affected generally. Only an indication of traffic-flow-shifts can be noted when comparing the different scenarios.	REQ-04.07.02-SPR-DRAM.1005 REQ-04.07.02-SPR-DRFM.1001
Traffic complexity/ number of interactions and conflicts	EXE-04.03-VP-797 Skyguide leg – FRA	- In the simulated area, FRA concept was considered not acceptable at FL305 due to the expected level of traffic and the number of interactions and conflicts to be managed between flights in vertical evolution and flights in cruise, which is expected to be very high and really difficult to manage at FL305. - In the simulated area, if the required concept adaptations are implemented, FRA concept was considered acceptable at FL365. The number of interactions and conflicts to be managed between flights in vertical evolution and flights in cruise is expected to be lower and manageable.	REQ-04.07.02-SPR-FR00.1004 REQ-04.07.02-SPR-FR00.1006

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
Human Performance/ Workload	EXE-04.03-VP-797 Skyguide leg - FRA	ATCOs situation awareness & workload, traffic complexity, number of conflicts and STCA alerts show that FRA concept tested during this exercise could lead to a reduction of ATC sectors capacity.	REQ-04.07.02-SPR-FR00.1004 REQ-04.07.02-SPR-FR00.1006
Human Performance/ Workload	EXE-04.03-VP-797 DSNA leg - FRA	Workload results did not show any impact of FRA on workload. Hence, airspace capacity was maintained in FRA. However, adverse impact of FRA on workload, and hence on capacity, would probably be observed for medium complexity traffic scenarios in absence of MTCD.	REQ-04.07.02-SPR-FR00.1004
Human Performance/ Workload	EXE-04.03-VP-798 DSNA leg - DRA	The proposed Direct Routing did not degrade the overall En-route airspace capacity if the usual rules of airspace design are followed when designing the DRA.	REQ-04.07.02-SPR-DRAM.1005 REQ-04.07.02-SPR-DRFM.1001
Human Performance/ Workload	EXE-04.03-VP-798 DSNA leg - FRA	The proposed FRA decreased the En-route airspace capacity compared to ARN with an equivalent level of Safety and Human Performance as in ATS Route Network. FRA in Low to Medium complexity (without E sector) increases the PC's workload, which nevertheless remains acceptable. Nevertheless, if high peaks of traffic load and/or complexity would happen, the workload could be unmanageable. Workload management and anticipation of complexity variation will be key matter to monitor and manage in FRA environment.	REQ-04.07.02-SPR-FR00.1004 REQ-04.07.02-SPR-FR00.1006
Capacity: Sector Occupancy, Throughput, Conflicts	FREE SOLUTIONS	Sector occupancy: not significant enough ACC throughput: not significant enough Sector workload: not significant enough Conflicts: not significant enough	REQ-04.07.02-SPR-DRAM.1005 REQ-04.07.02-SPR-DRFM.1001 REQ-04.07.02-SPR-FR00.1004

A.1.4.3 Operational Efficiency

Operational Efficiency for airspace users has been identified as key within the SESAR R&D framework (although not formally part of the B.05 Performance Framework). In the European ATM master Plan Edition 2015 [20], operational efficiency is translated into measurements of delay and fuel savings, in order to be useable by the SES Performance Scheme under the environment and capacity KPAs.

A summary of key validation results and linked performance requirements related to Operational Efficiency is provided hereafter.

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
Fuel Burn	EXE-07.05.03-VP-465	- The average fuel saving per UPR FPL was between 0.11% and 0.21% compared to non UPR FPLs. - Aircraft utilising a more flexible route and approach using intermediate points for flight planning can maximise fuel saving. - Fuel saving per mile is dependent on airline strategy and approach to implementing UPR FPLs.	REQ-04.07.02-SPR-FR00.1001 REQ-04.07.02-SPR-FR00.1002
Fuel Burn	EXE-07.05.03-VP-571	- Fuel burn reduced by 6-12% comparing DCTs with the fixed ATS route network.	REQ-04.07.02-SPR-DRAM.1001 REQ-04.07.02-SPR-DRAM.1002
Distance Flown	EXE-07.05.03-VP-465	Results show an average distance reduction of between 0.15% and 0.26%.	REQ-04.07.02-SPR-FR00.1001 REQ-04.07.02-SPR-FR00.1002
Distance Flown	EXE-07.05.03-VP-571	Average flown distance reduction of 7% between DCT routes and the fixed ATS route network, for the whole MUAC area, which represents 13NM gained per flight.	REQ-04.07.02-SPR-DRAM.1001 REQ-04.07.02-SPR-DRAM.1002
Fuel Burn	WE-FREE	WE FREE cross-border direct routes saved an average 6 tons of Fuel per day	REQ-04.07.02-SPR-DRAM.1001 REQ-04.07.02-SPR-DRAM.1003
Distance Flown	WE-FREE	In the tactical operations, the use of WE FREE routings reduced Horizontal deviation by 1% compared to the current tactical situation.	REQ-04.07.02-SPR-DRAM.1001 REQ-04.07.02-SPR-DRAM.1003

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
Analysis of flight costs	WE-FREE	Cost analysis done by AF shows: -a difference in over flight cost repartition between ATC -a reduction of over flight fees of 2% for CDG FCO via BUBLI and of 6% for CDG LIN via BUBLI.	REQ-04.07.02-SPR-DRAM.1001 REQ-04.07.02-SPR-DRAM.1003
Distance Flown	FRAMAK	Reduction by 6.8 NM per flight (-0.6%). For weekend traffic FPL routings have become shorter by 9.1 NM per flight (-0.8%)	REQ-04.07.02-SPR-DRAM.1001 REQ-04.07.02-SPR-DRAM.1003
Distance Flown	FRAMAK	Reduction by 3.7 NM (-0.3%) per flight. For weekend traffic Actual flown routes per flight are 3.9 NM shorter (-0.3%).	REQ-04.07.02-SPR-DRAM.1001 REQ-04.07.02-SPR-DRAM.1002 REQ-04.07.02-SPR-DRAM.1003
Distance Flown	FRAMAK	Based on FPL routings fuel burn decreased by 107.5 kg (-0.8%) per flight (weekend traffic: -145.1 kg /-1.1%). Based on actual flown routes fuel burn decreased by 56.4 kg (-0.4%) per flight (weekend: -95.3 kg / -0.7%)	REQ-04.07.02-SPR-DRAM.1001 REQ-04.07.02-SPR-DRAM.1002 REQ-04.07.02-SPR-DRAM.1003
Fuel Burn	EXE-04.03-VP-797 FOC assessment	Depending on the detailed Free Route environment, average fuel savings of up to 2.53% were achieved	REQ-04.07.02-SPR-FR00.1001 REQ-04.07.02-SPR-FR00.1002 REQ-04.07.02-SPR-FRAM.1002 REQ-04.07.02-SPR-FRAM.1003 REQ-04.07.02-SPR-FRAM.1004
Analysis of flight costs	EXE-04.03-VP-797 FOC assessment	Depending on the detailed Free Route environment, average cost savings of up to 1.37% were achieved	REQ-04.07.02-SPR-FR00.1001 REQ-04.07.02-SPR-FR00.1002 REQ-04.07.02-SPR-FRAM.1002 REQ-04.07.02-SPR-FRAM.1003 REQ-04.07.02-SPR-FRAM.1004

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
Fuel Burn	FREE SOLUTIONS	Overall Fuel Burn saved (for 1,002 flight trials): 34,574Kg	REQ-04.07.02-SPR-DRAM.1001 REQ-04.07.02-SPR-DRAM.1003 REQ-04.07.02-SPR-FR00.1001 REQ-04.07.02-SPR-FR00.1002
Distance Flown	FREE SOLUTIONS	Overall distance flown saved (for 1,002 flight trials): 4,482 NM	REQ-04.07.02-SPR-DRAM.1001 REQ-04.07.02-SPR-DRAM.1003 REQ-04.07.02-SPR-FR00.1001 REQ-04.07.02-SPR-FR00.1002
Flight Time	FREE SOLUTIONS	Overall Time saved (for 1,002 flight trials): 847 min	REQ-04.07.02-SPR-DRAM.1001 REQ-04.07.02-SPR-DRAM.1003 REQ-04.07.02-SPR-FR00.1001 REQ-04.07.02-SPR-FR00.1002

A.1.4.4 Predictability

Predictability addresses the ability of the ATM system to ensure a reliable and consistent level of 4D trajectory performance. In other words: across many flights, the ability to control the variability of the deviation between the actually flown 4D trajectories of aircraft in relationship to the Reference Business Trajectory The negative impact of this KPA must be seen when predictability decrease.

A summary of key validation results and linked performance requirements related to Predictability is provided hereafter.

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
Predictability	EXE-07.05.03-VP-465	Results showed that 91% of UPR FPLs were flown as planned compared to 78% of non UPR FPLs	REQ-04.07.02-SPR-FR00.1005 REQ-04.07.02-SPR-FRFP.1002
Flexible Flight Planning	EXE-07.05.03-VP-465	Airlines utilising a more flexible method to create UPR FPLs using intermediate points for flight planning were more capable at maximising fuel saving.	REQ-04.07.02-SPR-FRFP.0104 REQ-04.07.02-SPR-FRFP.0103 REQ-04.07.02-SPR-FR00.1002 REQ-04.07.02-SPR-FRFP.1002
Flexible Flight Planning	EXE-07.05.03-VP-465	UPR FPLs have the potential to use the flexibility provided by the concept to optimise for distance,	REQ-04.07.02-SPR-FRFP.0104

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
		wind, weather, ATC costs etc. hence produce consistent fuel savings Airlines were able to create and file UPR FPLs that met their optimisation requirements	REQ-04.07.02-SPR-FR00.1002 REQ-04.07.02-SPR-FRFP.0103 REQ-04.07.02-SPR-FRFP.0105 REQ-04.07.02-SPR-FRFP.1002
Flexible Flight Planning	EXE-07.05.03-VP-465	The UPR concept was deemed acceptable by airlines, due to gains in flight cost optimisation and flexibility	REQ-04.07.02-SPR-FR00.1002 REQ-04.07.02-SPR-FRFP.0103 REQ-04.07.02-SPR-FRFP.0104 REQ-04.07.02-SPR-FRFP.0105 REQ-04.07.02-SPR-FRFP.1002
AFTM delay history	WE-FREE	No impact on punctuality	REQ-04.07.02-SPR-DRFM.1002
ATFCM delays	EXE-04.03-VP-797 Skyguide leg - FRA	Assessment of the NM revealed a huge number of new hotspot within the considered FRA airspace. Therefore, it was decided to focus on hotspots over the simulated area. DCB measures taken to reduce these hotspots increased drastically number of regulated flights and ATFCM En-Route delay per delayed flights.	REQ-04.07.02-SPR-FR00.1005 REQ-04.07.02-SPR-FR00.1007
ATFCM delays	FREE SOLUTIONS	No negative effects - No ATFCM delay attributed to trial city pair DCTs - No ATFCM delay attributed to DRs - No ATFCM delay attributed to flights of the FRA trial	REQ-04.07.02-SPR-DRFM.1002 REQ-04.07.02-SPR-FR00.1005

A.1.4.5 Human Performance

A summary of key validation results and linked Human Performance (and system performance) requirements is provided hereafter.

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
Workload	EXE-07.05.03-VP-465	86% of ATCOs report no change in workload when controlling en-route flights flown with UPR FPLs. 83% of ATCOs report no change in workload when controlling departing/arriving flights flown with UPR FPLs.	REQ-04.07.02-SPR-FRPC.1003 REQ-04.07.02-SPR-FRPC.1005 REQ-04.07.02-SPR-FRPC.1006 REQ-04.07.02-SPR-FRPC.1007 REQ-04.07.02-SPR-FRPC.1009 REQ-04.07.02-SPR-FRPC.1010 REQ-04.07.02-SPR-FRTC.1001 REQ-04.07.02-SPR-FRTC.1002 REQ-04.07.02-SPR-FRTC.1003 REQ-04.07.02-SPR-FRTC.1005 REQ-04.07.02-SPR-FRTC.1006 REQ-04.07.02-SPR-FRTA.1002
Workload	EXE-07.05.03-VP-465	- Although there were some coordination issues, 74% of ATCOs said that they received sufficient information from the previous sector regarding the UPR FPL.	REQ-04.07.02-SPR-FRPC.1001 REQ-04.07.02-SPR-FRPC.1002 REQ-04.07.02-SPR-FRPC.1008
UPR concept acceptability	EXE-07.05.03-VP-465	ATCOs accepted the UPR concept as it was not seen to have a negative impact on Human Performance or airspace safety.	REQ-04.07.02-SPR-FR00.1004 REQ-04.07.02-SPR-FR00.0101

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
Workload	EXE-07.05.03-VP-571	- ATCOs felt the concept was acceptable during low traffic periods. - On average human performance was thought to be unaffected by all scenarios (based on average results for all scenarios). On average 57% of ATCOs felt scenarios were safe (based on average result for all scenarios).	REQ-04.07.02-SPR-DRAM.1005
Workload	EXE-07.05.03-VP-571	- 92% of ATCOs said that the workload was at an acceptable level. - ATCOs approved low traffic and 24 hour operational routes for implementation despite a slight increase in complexity.	REQ-04.07.02-SPR-DRAM.1005
Workload	FRAMAK	- The FTS simulation provided acceptable average workload values but predominantly too high peak values, particularly in WE-option. A significant increase in operator workload due to cross-border DCT-operations is not given. - Increased workload I RTS for updating trajectories (vectoring more often required due to missing intermediate points) - Design (of cross-border DCTs) improvements introduced during the RTS improved workload.	REQ-04.07.02-SPR-DRAM.1005
Workload	WE-FREE	No significant increase of workload during the trial	REQ-04.07.02-SPR-DRAM.1005
Workload	EXE-04.03-VP-798 DSNA leg - DRA	ATCOs' workload seemed to remain acceptable in DRA. According to controllers, each long range direct routing should be properly designed to avoid extra workload and when the number of DCTs is limited, DRA was not so much different from fixed route.	REQ-04.07.02-SPR-DRAM.1005
Workload	EXE-04.03-VP-798 DSNA leg - DRA	In Direct Routing environment of high and very high complexity, both PC/TC controllers need access to the mid-term CD/R aid and it should be available and designed for both of them.	REQ-04.07.02-SPR-DRPC.0107 REQ-04.07.02-SPR-DRTC.0201 REQ-04.07.02-SPR-DRPC.1004 REQ-04.07.02-SPR-DRPC.1005 REQ-04.07.02-SPR-DRPC.1006 REQ-04.07.02-SPR-DRPC.1102

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
Workload	EXE-04.03-VP-798 DSNA leg - DRA	TCT was considered as being a second layer of safety net and definitely helped the controllers but cannot be considered as mandatory in the tested DRA	REQ-04.07.02-SPR-DRTC.0202 REQ-04.07.02-SPR-DRTC.1002 REQ-04.07.02-SPR-DRTC.1003 REQ-04.07.02-SPR-DRTC.1004
Workload	EXE-04.03-VP-798 DSNA leg - DRA	In Direct Routing environment of high and very high complexity, the ATCOs (Planning Controller and the Tactical Controller) shall be provided with a tool to determine the minimum distance between aircraft trajectories with a long look ahead time (e.g. SEP tool roughly 20 min in advance).	REQ-04.07.02-SPR-DRTC.1001
Situational awareness	EXE-04.03-VP-798 DSNA leg - DRA	Situation Awareness scores remain acceptable. DRA is not so much an issue for ATCO if they have time to learn and master the Direct Routings, and the number of DCTs remains reasonable per sector and designed in line with current rules of route design in order to take into account all the environmental constraint like sector shape.	REQ-04.07.02-SPR-DRAM.1005
Situational awareness	EXE-04.03-VP-798 DSNA leg - DRA	In Direct Routing environment of high and very high complexity, the ATCOs (Planning Controller and Tactical Controller) shall be provided with the display of the planned 2D trajectory of a selected aircraft.	REQ-04.07.02-SPR-DRPC.0106 REQ-04.07.02-SPR-DRPC.1002 REQ-04.07.02-SPR-DRPC.1003
Team communication	EXE-04.03-VP-798 DSNA leg - DRA	Overall team communication ratings have been on a high level in all scenarios. Consistent with the expectations, team communication remained at an acceptable level in the DRA scenarios; either with respect to TC-PC communication or to PC-PC communication (i.e. inter-sector coordination).	REQ-04.07.02-SPR-DRPC.1103 REQ-04.07.02-SPR-DRPC.0103 REQ-04.07.02-SPR-DRPC.1101

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
Workload/ Situational awareness/ Team communication	EXE-04.03-VP-798 ENAV leg - DRA	From ATCOs feedback, it can be state that DRA operations with seamless coordination and transfer can be performed supported by IOP mechanisms improving ATCOs activity in terms of mental workload, trust in the concept, single/shared situational awareness, task time execution, communications and coordination's, job satisfaction.	REQ-04.07.02-SPR-DRPC.0103 REQ-04.07.02-SPR-DRPC.1001 REQ-04.07.02-SPR-DRPC.1101
IOP-G concept usability	EXE-04.03-VP-798 ENAV leg - DRA	There is a positive tendency in considering IOP-G as good concept to improve ATM but it is necessary to take care to all other results (re-built of airspace, roles and responsibilities of PC and TC etc.).	REQ-04.07.02-SPR-DRPC.0108 REQ-04.07.02-SPR-DRPC.0204 REQ-04.07.02-SPR-DRPC.0205 REQ-04.07.02-SPR-DRPC.1102
Workload	EXE-04.03-VP-798 DSNA leg - FRA	All controllers reported that a good MTCD was mandatory in FRA whatever the level of traffic density or complexity was. Any CD/R tool shall display encounters within the sector and near its boundaries, i.e. in the area of interest of the sector as participants promoted the "good neighbour" behaviour in FRA.	REQ-04.07.02-SPR-FRPC.0107 REQ-04.07.02-SPR-FRPC.0204 REQ-04.07.02-SPR-FRPC.1003 REQ-04.07.02-SPR-FRPC.1005 REQ-04.07.02-SPR-FRPC.1006 REQ-04.07.02-SPR-FRPC.1007 REQ-04.07.02-SPR-FRPC.1102
Workload	EXE-04.03-VP-798 DSNA leg - FRA	In Free Routing Airspace, the ATCOs (Planning Controller and the Tactical Controller) shall be provided with a tool to determine the minimum distance between aircraft trajectories with a long look-ahead time (e.g. SEP tool roughly 20 min in advance).	REQ-04.07.02-SPR-FRTC.1001

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
Workload	EXE-04.03-VP-798 DSNA leg - FRA	Even if the TCT tool brings a huge added value, it should not be considered as mandatory in Low to medium FRA environment as these complexities was manageable without it.	REQ-04.07.02-SPR-FRTC.0202 REQ-04.07.02-SPR-FRTC.1002 REQ-04.07.02-SPR-FRTC.1003 REQ-04.07.02-SPR-FRTC.1004
Workload	EXE-04.03-VP-798 DSNA leg - FRA	MONA shall be mandatory in FRA, as ATCO need to be assured that the aircraft follows its planned trajectory without any deviation as flight routes vary a lot in FRA from one flight to another. The controllers cannot remember precisely the routes of all the flights they integrated.	REQ-04.07.02-SPR-FRTA.0101 REQ-04.07.02-SPR-FRTA.1002
Situational awareness	EXE-04.03-VP-798 DSNA leg - FRA	In Low to Medium FRA, the level of situation awareness seems acceptable after a transition time but with more involved cognitive resource (i.e. workload and fatigue).	REQ-04.07.02-SPR-FRPC.1002 REQ-04.07.02-SPR-FRTC.1005 REQ-04.07.02-SPR-FRTC.1006
Situational awareness	EXE-04.03-VP-798 DSNA leg - FRA	The ATCOs (Planning Controller and Tactical Controller) shall be provided with the display of the planned 2D trajectory of a selected aircraft.	REQ-04.07.02-SPR-FRPC.0106 REQ-04.07.02-SPR-FRPC.1009 REQ-04.07.02-SPR-FRPC.1010
Team communication	EXE-04.03-VP-798 DSNA leg - FRA	Team communication remained at an acceptable level in the FRA scenario, whether it is TC-PC communication (except on the E sector as the controllers were too busy to properly communicate and collaborate) or PC-PC communication (i.e. inter-sector coordination).	REQ-04.07.02-SPR-FRPC.1101 REQ-04.07.02-SPR-FRPC.0103 REQ-04.07.02-SPR-FRPC.1008
Workload/ Situational awareness/ Team communication	EXE-04.03-VP-798 ENAV leg - FRA	From ATCOs feedback, it can be state that FRA concept with seamless coordination and transfer can improve ATCOs activity in terms of mental workload, trust in the concept, single/shared situational awareness, task time execution, communications and coordination's, job satisfaction.	REQ-04.07.02-SPR-FRPC.1001 REQ-04.07.02-SPR-FRPC.0103 REQ-04.07.02-SPR-FRPC.1008

KPI Assessed	Related Validation exercise	Results	Linked Performance Requirements
IOP-G concept usability	EXE-04.03-VP-798 ENAV leg - FRA	Both PC and EC feedback point out a significant potentiality in applying IOP concept comparing with OLDI's one it's necessary to say that the IOP concept it would be useful only with the addition of other needs like restructure of Italian airspace, strong and manageable platform system and a review of PC and TC roles and responsibilities (consider also the fact that in a FRA environment, due to its features, there is more flexibility for ATCO comparing to DRA environment)	REQ-04.07.02-SPR-FRPC.0108 REQ-04.07.02-SPR-FRPC.0203 REQ-04.07.02-SPR-FRPC.0205 REQ-04.07.02-SPR-FRPC.1102
Workload /situational awareness	FREE SOLUTIONS	Mental workload remained at proper level without negative effects for both pilots and controllers. Situational awareness: No major changes and in some cases even augmented	REQ-04.07.02-SPR-DRAM.1005

A.1.4.6 References to OFA assessments

For further details, below are the links to operational assessments performed in the context of Validation Exercises of the OFA validation path:

Validation Exercise	Key Performance Area	Operational Performance Assessments
EXE-07.05.03-VP-465	Flight Efficiency/ Cost Efficiency Predictability Human Performance	Validation Report [34], section 6.2.3.1.1.1 Validation Report [34], section 6.2.3.1.1.2 Validation Report [34], section 6.2.3.1.2.x
EXE-07.05.03-VP-571	Flight Efficiency Capacity Human Performance	Validation Report [34], section 6.1.3.1.2.1 Validation Report [34], section 6.1.3.1.2.2 Validation Report [34], section 6.1.3.1.1.2
FRAMAK	Flight Efficiency Capacity Predictability Cost Effectiveness (Sectorisation) Human Performance (Workload/Operational feasibility)	Demonstration Report [28], sections 5.2.1.1 and 5.2.1.2 Demonstration Report [28], section 5.2.1.5 Demonstration Report [28], section 5.2.1.6 Demonstration Report [28], section 5.2.1.7 Demonstration Report [28], sections 5.2.1.8 and 5.2.1.9

Validation Exercise	Key Performance Area	Operational Performance Assessments
WE-FREE	Flight efficiency/Cost efficiency	Demonstration Report [27], sections 5.1.3.1.2 and 5.1.3.1.3
	Capacity (including impact on ATFCM delays and ATCO's Workload)	Demonstration Report [27], sections 5.1.3.3
EXE-04.03-VP-797 Skyguide and DSNA legs	Environment – Fuel Efficiency	Validation Report [30], sections 6.1.3.1.2.6 and 6.2.3.1.2.6
	Operation Efficiency (including Fuel Efficiency and AU Cost Effectiveness)	Lufthansa Systems contribution to VP797 Validation Report [35], sections 4.1.2 and 4.2
	Predictability	Validation Report [30], sections 6.1.3.1.2.5 and 6.2.3.1.2.5
	Capacity	Validation Report [30], sections 6.1.3.1.2.3 and 6.2.3.1.2.3
	Human Performance	Validation Report [30], sections 6.1.3.1.2.1 and 6.2.3.1.2.1
EXE-04.03-VP-798 DSNA leg – DRA and FRA	Environment – Fuel Efficiency	Validation Report [31], section 6.1.3.3.4
	Predictability	Validation Report [31], section 6.1.3.3.3
	Capacity	Validation Report [31], section 6.1.3.3.2
	Human Performance	Validation Report [31], section 6.1.3.3.5
EXE-04.03-VP-798 ENAV leg – DRA and FRA	Human Performance	Validation Report [31], section 6.3.3.3.2
FREE SOLUTIONS	Environment – Fuel Efficiency	Demonstration Report [29], sections 6.1.3.1.1.1, 6.3.3.1.1.1 and 6.4.3.1.1.1
	Airspace Capacity – En Route (including impact on ATFCM delays)	Demonstration Report [29], sections 6.1.3.1.1.2, 6.3.3.1.1.2 and 6.4.3.1.1.2
	Predictability and ATC planning	Demonstration Report [29], sections 6.1.3.1.1.3, 6.3.3.1.1.3 and 6.4.3.1.1.3
	Human Performance	Demonstration Report [29], sections 6.1.3.1.1.5, 6.3.3.1.1.5 and 6.4.3.1.1.5

A.2 Safety and Performance Recommendations

This section describes the safety and performance recommendations related to the SESAR Solutions #32 and #33. The recommendations show traceability to the operational requirements (applicable to Processes and Services (P&S)) as described in the OSED.

Recommendations have been written using SESAR Requirements and V&V Guidelines [2].

Their description uses the layout described in SESAR Templates and Toolbox User Manual [3].

Note to the reader: The safety and performance recommendations listed hereafter (that use the operative verb "**should**") are considered as "Important" to improve the safety and performance aspects of the SESAR Solutions #32 and #33 in all applicable environments.

These recommendations are linked to optional operational procedures / supporting technologies and have to be considered as recommended practice where applicable taking into account the local AU or ATS environment characteristics.

It has been adopted the same principles to identify the Safety and Performance Recommendations than for the Requirements in section 3, apart from the Reference number which is as follows:

- XXYY: Reference number defined as a sequence of four digits, the two first digits indicating if the recommendation relates to safety or performance and the two last being an increment in the numbering, i.e.
  - XX:
    - 02 for Safety functional recommendation
    - 11 for Performance recommendation
  - YY: Incremented for each recommendation

A.2.1 SESAR Solution #32 - Direct Routing across ACC/FIR borders and in high complexity environments

A.2.1.1 Safety recommendations

A.2.1.1.1 Functional safety recommendations for BT/MT Flight Planning

[REQ]

Identifier	REQ-04.07.02-SPR-DRFP.0201
Requirement	ANSP, Airspace Users and Network Manager should have the same level of information in flight planning phase regarding flight profile and routing in Direct Routing environment
Title	Flight profile information collection and distribution in Direct Routing environment
Status	<Validated>
Rationale	Such "level of information" will concern both the initial flight plan intentions and any subsequent revisions to this information. Same level of information does not necessarily means same data. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_001 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance

<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR11.0110	<Full>
<ALLOCATED_TO>	<Functional block>	Flight Management	N/A
<ALLOCATED_TO>	<Functional block>	FPLD	N/A

A.2.1.1.2 Functional safety recommendations for Airspace Management

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.0201
Requirement	Direct segments leading to conflict close to sector/ATSU boundaries should not be defined/published in Direct Routing environment
Title	Avoid direct segments leading to conflict in border of the sector
Status	<Validated>
Rationale	Sector close to sector boundaries might lead to complex unsafe situation. Most conflict in border of the sector induces high workload. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_006 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0111	<Full>

A.2.1.1.3 Functional safety recommendations for ATFCM

No functional safety recommendation relating to ATFCM for Direct Routing operations across ACC borders and in high complexity environments.

A.2.1.1.4 Functional safety recommendations for Planning Separation Assurance

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0201
Requirement	In support to Direct Routing operations across ACC/FIR borders, the display of planned 2D trajectory of a selected flight should be possible beyond the ATSU boundary
Title	Display of selected planned 2D trajectory in cross-border Direct Routing environment
Status	<Validated>
Rationale	In complex Direct Routing operations, a tool allowing the display of the planned 2D trajectory of at least one selected flight is essential for ATCOs to build her/his mental image of the situation. In case of Direct routings across ACC/FIR borders, the displayed trajectory would need to be possible beyond the ATSU boundary. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_024 of the Safety Assessment Report in section A.1.1
Category	<Performance>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0240	<Full>
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0202
Requirement	In Direct Routing environment of high complexity, the Planning Controller should be provided with a CWP HMI facility to unambiguously identify a selected flight to the Planning Controller of any adjacent sector, for the purpose of inter-sector coordination
Title	Point of a selected aircraft between two sectors in direct routing environment
Status	<Validated>
Rationale	With lack of named Coordination Point, ability to communicate unambiguously about a given aircraft will ease the coordination of flight between ATCOs of adjacent sectors. However experience of early Direct Routing implementation has shown that this is not mandatory for ATCO to be provided with such a functionality (ATCOs can ensure coordination with phone and/or electronic coordination of flights inside the FRA) CWP HMI facility could be a trajectory display/editor, and not necessarily a point-out functionality This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_023 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0215	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0203
Requirement	In Direct Routing environment of high complexity, the Planning Controller should be provided with a What-if facility to support the negotiation of coordination conditions
Title	Coordination What-if in Direct Routing environment
Status	<Validated>
Rationale	With no fixed coordination point, the coordination of flights in direct routing environment would take advantage of a support to unambiguously exchange about a given aircraft. In IOP environment, conflict detection could be handled at sector level before coordination of flight, thus this functionality is nice-to-have rather than an essential function. This requirement is justified by Safety Assessment: see Safety Objective see SO_DRA_023 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0228	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0204
Requirement	In Direct Routing environment of high complexity, the ATCOs (Planning Controller and Tactical Controller) should be provided with support tool to determine the minimal predicted separation between two selected flights on their planned trajectories within the area of interest of the sector
Title	Minimal predicted separation between two selected flights in Direct Routing environment
Status	<Validated>
Rationale	With no classical route scheme, the ATCO needs a support to analyse the air situation and notably the potential loss of separation between two planned trajectories. This support has to be provided at least within the Area of Responsibility (such a tool is considered as baseline). Support within the whole Area of Interest of the sector will limit the need for coordination, particularly for conflict in border of the sector, but is not considered as mandatory. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_025 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0242	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.0205
Requirement	In Direct Routing environment of high complexity, Conflict Detection / Resolution Tool for PC should handle predicted infringement of active ARES (within the area of interest) by flights
Title	Prediction of infringement of active ARES in Direct Routing environment
Status	<Validated>
Rationale	With no classical route scheme, the ATCOs need a support to identify the flight that might infringe an active ARES. This is particularly true in environment with AFUA where dimension of the active ARES can vary from one day to the other. This support has to be provided at least within the Area of Responsibility (such a tool is considered as baseline). Support within the whole Area of Interest of the sector will limit the need for coordination, particularly for ARES in border of the sector, but is not considered as mandatory. For example, the display of both the ARES (both the structure and the real-time status update) and the planned trajectory will permit to visually detect

	any 2D-encounter This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_028 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0227	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

A.2.1.1.5 Functional safety recommendations for Tactical Separation Assurance

[REQ]

Identifier	REQ-04.07.02-SPR-DRTC.0201
Requirement	In Direct Routing environment of high complexity, the Tactical Controller should be provided with trajectory-based Conflict Detection Tool to support the mid-term detection of encounters between two flights
Title	Mid-term Conflict Detection support tool for Tactical Separation in Direct Routing environment
Status	<Validated>
Rationale	To manage Direct Routing operations in high complexity airspace, it is deemed useful to support the TC to assess the global air situation. Such a global assessment may lead the TC to anticipate and optimize the resolution of tactical conflicts. A mid-term detection of encounters permits to predict potential loss of separation between two planned trajectories of interest for the sector (20 minutes time horizon as an order of magnitude). This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_026 of the Safety Assessment Report in section A.1.1
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0232	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRTC.0202
Requirement	In Direct Routing environment of high complexity, the Tactical Controller should be provided with a Conflict Detection Tool to support the detection of tactical encounters between two flights
Title	Tactical Conflict Detection support tool in Direct Routing environment
Status	<Validated>
Rationale	To manage Direct Routing operations in high complexity airspace, the TC would need a support to assess tactical situations involving flights that do

	not follow any familiar route scheme. A detection of tactical encounters permits to predict potential loss of separation between two tactical trajectories with a a predefined time horizon. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_029 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0230	<Full>
<ALLOCATED TO>	<Functional block>	CONF	N/A
<ALLOCATED TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRTC.0203
Requirement	In Direct Routing environment of high complexity, the Tactical Controller should be provided with a tactical What-Else probing
Title	Tactical What-Else in Direct Routing environment
Status	<Validated>
Rationale	In an airspace where a high proportion of aircraft may evolve in the vertical dimension, it is very useful for the TC to be provided with a support to solve tactical conflicts. It may also happen that, due to DCTs, conflicts occur between two trajectories with small angle, requiring an uneasy and unfamiliar resolution. It may also happen that two conflicts occur closely but not sharing the same crossing point, which unease their mutual resolution. In such cases, supporting tools for conflict resolution are welcome. A tactical What-else probing assesses the impact of several speculative tactical trajectories (and associated data arising from What-If Probing) on the occurrence of predicted encounters. This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_030 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0236	<Full>
<ALLOCATED TO>	<Functional block>	CONF	N/A

A.2.1.1.6 Functional safety recommendations for Ensuring Trajectory Adherence

[REQ]

Identifier	REQ-04.07.02-SPR-DRTA.0201
Requirement	In Direct Routing environment of high complexity, the ATCOs should be supported by a MONA tool to monitor the flight adherence to the tactical trajectory

Title	Route adherence monitoring in Direct Routing environment
Status	<Validated>
Rationale	In Direct Routing operations in high complexity airspace, the ATCOs can hardly monitor by themselves the route adherence of flights with an unfamiliar route (particularly when a significant number of direct segments are published). This requirement is justified by Safety Assessment: see Safety Objective SO_DRA_033 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0250	<Full>
<ALLOCATED TO>	<Functional block>	MONA	N/A

A.2.1.1.7 Functional safety recommendations for Ground-Based Safety Nets

No functional safety recommendation relating to Ground Based Safety Nets for Direct Routing operations across ACC/FIR borders and in high complexity environments.

A.2.1.2 Performance recommendations

A.2.1.2.1 Performance recommendations for BT/MT Flight Planning

A.2.1.2.1.1 Operational efficiency (including fuel efficiency)

[REQ]

Identifier	REQ-04.07.02-SPR-DRFP.1101
Requirement	Airspace Users should use an automated tool to support optimized flight planning in Direct Routing environment
Title	Support to Flight Planning of Direct Routings by AU
Status	<Validated>
Rationale	The support provided to Airspace Users would need to be automated and allow efficient flight planning according to their needs, e.g. mapping tool, automatic Flight Planning tool, etc. This support tool would be necessary to deal with the huge amount of data to be considered and will be useful to determine an optimised flight plan. A tool visualising all Direct Segments constituting a Direct Routing can help Airspace Users as only Direct Segments constituting a Direct Routing is expected to be published, not Direct Routings. An automatic flight planning tool capable of handling Direct Segments and determine optimum fight plan in Direct Routing environment is another option.
Category	<Performance>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES TO>	<Operational Focus Area>	OFA03.01.03	N/A

<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR11.0182	<Full>
<ALLOCATED_TO>	<Functional block>	Data Management	N/A
<ALLOCATED_TO>	<Functional block>	Flight Management	N/A

A.2.1.2.2 Performance recommendations for Airspace Management

A.2.1.2.2.1 Operational Efficiency (including fuel efficiency)

[REQ]

Identifier	REQ-04.07.02-SPR-DRAM.1101
Requirement	In Direct Routing environment of high complexity, the number of short Direct Segments subject to RAD restrictions should be kept as low as possible
Title	Limited number of short Direct Segments in a Direct Routing environment
Status	<Validated>
Rationale	There might be a flight planning issue (from AU's perspective) if too many short Direct Segments with complex restrictions are published for the whole European airspace.
Category	<Performance>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR07.0141	<Full>

A.2.1.2.3 Performance recommendations for ATFCM

No performance recommendation relating to ATFCM for Direct Routing operations across ACC borders and in high complexity environments.

A.2.1.2.4 Performance recommendations for Planning Separation Assurance

A.2.1.2.4.1 System Performance

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.1101
Requirement	In Direct Routing environment of high complexity, ATC coordination tools should support the negotiation of entry/exit conditions at sector level outside ATS routes and with unnamed coordination points
Title	Support tool for negotiation of entry/exit conditions in Direct Routing environment
Status	<Validated>
Rationale	To be efficient, coordination of flights in Direct Routing across ATSU/sector boundaries outside named Coordination Points would need to be supported by the ATC systems in order to negotiate entry/exit conditions at sector level.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0211	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.1102
Requirement	In Direct Routing environment of high complexity, the Conflict Detection Tool for PC should inform the controller about all relevant mid-term encounters: • involving at least of one distributed flight • and with detected conflict located within the sector area of interest
Title	Mid-term detection of relevant encounters by support tool in Direct Routing environment
Status	<Validated>
Rationale	To manage complex Direct Routing operations, the Conflict Detection Tool for PC is essential to support the mid-term detection of encounters. To be efficient, the tool would need to detect all relevant mid-term encounters in the sector area of interest.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0220	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

A.2.1.2.4.2 Human Performance

[REQ]

Identifier	REQ-04.07.02-SPR-DRPC.1103
Requirement	In Direct Routing environment of high complexity, the Planning Controller should be able to propose a conflict resolution action to the Tactical Controller by means of a CWP HMI function
Title	Proposal of a conflict resolution action through CWP in Direct Routing environment
Status	<Validated>
Rationale	To manage Direct Routing operations in high complexity airspace, it is deemed useful to support the TC in the management of tactical encounters. The proposal of a conflict resolution action by the PC by means of a CWP HMI function (e.g. free text added to aircraft label) might be helpful.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-DR04.0220	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

A.2.1.2.5 Performance recommendations for Tactical Separation Assurance

No performance recommendation relating to Tactical Separation Assurance in Direct Routing across ACC/FIR borders and in high complexity environments.

A.2.1.2.6 Performance recommendations for Ensuring Trajectory Adherence

No performance recommendation relating to Trajectory Adherence monitoring in Direct Routing across ACC/FIR borders and in high complexity environments.

A.2.1.2.7 Performance recommendations for Ground-Based Safety Nets

No performance recommendation relating to Ground Based Safety Nets in Direct Routing across ACC/FIR borders and in high complexity environments.

A.2.2 SESAR Solution #33 - Free Routing across ACC/FIR within permanently low to medium complexity environments

A.2.2.1 Safety recommendations

A.2.2.1.1 Functional safety recommendations for BT/MT Flight Planning

No safety recommendation relating to BT/MT in Planning for Free Routing across ACC/FIR borders within low to medium complexity environments.

A.2.2.1.2 Functional safety recommendations for Airspace Management

No safety recommendation relating to Airspace Management for Free Routing operations across ACC/FIR borders within low to medium complexity environments.

A.2.2.1.3 Functional safety recommendations for ATFCM

No functional safety recommendation relating to ATFCM for Free Routing operations across ACC/FIR borders within low to medium complexity environments.

A.2.2.1.4 Functional safety recommendations for Planning Separation Assurance

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0201
Requirement	In Free Routing Airspace, the Planning Controller should be provided with a CWP HMI facility to unambiguously identify a selected flight to the Planning Controller of any adjacent sector, for the purpose of inter-sector coordination
Title	Point of a selected aircraft between two sectors in FRA
Status	<Validated>
Rationale	With no airspace reference, ability to communicate unambiguously about a given aircraft will ease the coordination of flight between ATCOs of adjacent sectors. However experience of early FRA implementation has shown that this is not mandatory for ATCO to be provided with such a functionality (ATCOs can ensure coordination with phone and/or electronic coordination of flights inside the FRA) CWP HMI facility could be a trajectory display/editor, and not necessarily a point-out functionality This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_025 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance

<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0215	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0202
Requirement	In Free Routing Airspace, the Planning Controller should be provided with a What-if facility to support the negotiation of coordination conditions
Title	Coordination What-if in FRA
Status	<Validated>
Rationale	With no airspace reference, the coordination of flights in Free Routing Airspace would take advantage of a support to unambiguously exchange about a given aircraft. In IOP environment, conflict detection could be handled at sector level before coordination of flight, thus this functionality is nice-to-have rather than an essential function. This requirement is justified by Safety Assessment: see Safety Objective see SO_FRA_025 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0216	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0203
Requirement	In Free Routing Airspace, the ATCOs (Planning Controller and Tactical Controller) should be provided with support tool to determine the minimal predicted separation between two selected flights on their planned trajectories within the area of interest of the sector
Title	Minimal predicted separation between two selected flights in FRA
Status	<Validated>
Rationale	With no route scheme, the ATCOs need a support to analyse the air situation and notably the potential loss of separation between two planned trajectories. This support has to be provided at least within the Area of Responsibility (such a tool is considered as baseline). Support within the whole Area of Interest of the sector will limit the need for coordination, particularly for conflict in border of the sector, but is not considered as mandatory. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_029 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance

<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0242	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0204
Requirement	In Free Routing Airspace of stable low complexity, the Planning Controller should be provided with trajectory-based Conflict Detection Tool to support the mid-term detection of encounters between two flights
Title	Mid-term Conflict Detection support tool in FRA of low complexity
Status	<Validated>
Rationale	In Free Routing Airspace, the PC needs a support to assess the global air situation including flights that follow an unfamiliar route scheme. Also conflicts may occur at border between two sectors and the PC needs a support to detect such conflicts in advance. A mid-term detection of encounters permits to predict potential loss of separation between two planned trajectories of interest for the sector (20 minutes time horizon as an order of magnitude). This functionality is considered as a nice-to-have in stable low complexity environment. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_030 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0222	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0205
Requirement	In Free Routing Airspace, Conflict Detection / Resolution Tool for Planning Controller should handle predicted infringement of active ARES (within the area of interest of the sector) by flights
Title	Prediction of infringement of active ARES in FRA
Status	<Validated>
Rationale	With no route scheme, the ATCOs need a support to identify the flight that might infringe an active ARES. This is particularly true in environment with AFUA where dimension of the active ARES can vary from one day to the other. This support has to be provided at least within the Area of Responsibility (such a tool is considered as baseline). Support within the whole Area of Interest of the sector will limit the need for coordination, particularly for ARES in border of the sector, but is not considered as mandatory. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_031 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>

Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0220	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0206
Requirement	In Free Routing Airspace, ATCOs (Planning Controller and Tactical Controller) should be provided with a tool detecting the potential crossing between the planned trajectory of the aircraft and active en-route stack in the sector
Title	Detection of potential crossing between the planned trajectory and active en-route stack in FRA
Status	<Validated>
Rationale	Considering that there will be no strategic separation between trajectories of the aircraft and stack En Route, in free routing environment, it might be difficult for the ATCO to detect a crossing of an active en-route stack. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_032 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0220	<Partial>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.0207
Requirement	In support to Free Routing operations across ACC/FIR borders, the display of planned 2D trajectory of a selected flight should be possible beyond the ATSU boundary
Title	Display of selected planned 2D trajectory in cross-border FRA
Status	<Validated>
Rationale	In Free Routing Airspace, a tool allowing the display of the planned 2D trajectory of at least one selected flight is essential for ATCOs to build her/his mental image of the situation. In case of Free Routing across ACC/FIR borders, the displayed trajectory would need to be possible beyond the ATSU boundary. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_028 of the Safety Assessment Report in section A.1.1
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0240	<Full>

<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

A.2.2.1.5 Functional safety recommendations for Tactical Separation Assurance

[REQ]

Identifier	REQ-04.07.02-SPR-FRTC.0201
Requirement	In Free Routing Airspace, the Tactical Controller should be provided with trajectory-based Conflict Detection Tool to support the mid-term detection of encounters between two flights
Title	Mid-term Conflict Detection support tool for Tactical Separation in FRA
Status	<Validated>
Rationale	In Free Routing Airspace, it is deemed useful to support the TC to assess the global air situation. Such a global assessment may lead the TC to anticipate and optimize the resolution of tactical conflicts. A mid-term detection of encounters permits to predict potential loss of separation between two planned trajectories of interest for the sector (20 minutes time horizon as an order of magnitude). This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_030 of the Safety Assessment Report in section A.1.1
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0232	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRTC.0202
Requirement	In Free Routing airspace, the Tactical Controller should be provided with a Conflict Detection Tool to support the detection of tactical encounters between two flights
Title	Tactical Conflict Detection support tool in FRA
Status	<Validated>
Rationale	In Free Routing Airspace, the TC would need a support to assess tactical situations involving flights that do not follow any familiar route scheme. A detection of tactical encounters permits to predict potential loss of separation between two tactical trajectories with a predefined time horizon. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_033 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Real Time Simulation>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0230	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A

A.2.2.1.6 Functional safety recommendations for Ensuring Trajectory Adherence

No functional safety recommendation relating to Trajectory Adherence monitoring for Free Routing operations across ACC/FIR borders within low to medium complexity environments.

A.2.2.1.7 Functional safety recommendations for Ground-Based Safety Nets

[REQ]

Identifier	REQ-04.07.02-SPR-FRSN.0201
Requirement	STCA settings should be adapted to free routing operations
Title	STCA settings in FRA
Status	<Validated>
Rationale	There might be a need to adapt the settings of the STCA system to the free routing environment This recommendation is justified by Safety Assessment: see Safety Objective SO_FRA_036 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0810	<Full>
<ALLOCATED_TO>	<Functional block>	SNET	N/A

[REQ]

Identifier	REQ-04.07.02-SPR-FRSN.0202
Requirement	APW settings should be adapted to free routing operations
Title	APW settings in FRA
Status	<Validated>
Rationale	There might be a need to adapt the settings of the APW system to the free routing environment. This requirement is justified by Safety Assessment: see Safety Objective SO_FRA_037 of the Safety Assessment Report in section A.1.1
Category	<Safety>
Validation Method	<Expert Group (Judgement Analysis)>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0820	<Full>
<ALLOCATED_TO>	<Functional block>	SNET	N/A

A.2.2.2 Performance recommendations

A.2.2.2.1 Performance recommendations for BT/MT Flight Planning

No performance recommendation relating to BT/MT Flight Planning for Free Routing operations across ACC/FIR borders within low to medium complexity environments.

A.2.2.2.2 Performance recommendations for Airspace Management

No performance recommendation relating to Airspace Management for Free Routing operations across ACC/FIR borders within low to medium complexity environments.

A.2.2.2.3 Performance recommendations for ATFCM

No performance recommendation relating to ATFCM for Free Routing operations across ACC/FIR borders within low to medium complexity environments.

A.2.2.2.4 Performance recommendations for Planning Separation Assurance

A.2.2.2.4.1 Human Performance

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.1101
Requirement	In Free Routing Airspace, the Planning Controller should be able to propose a conflict resolution action to the Tactical Controller by means of a CWP HMI function
Title	CWP HMI function for proposal of conflict resolution in FRA
Status	<Validated>
Rationale	To manage Free Routing operations, it is deemed useful to support the TC in the management of tactical encounters. The proposal of a conflict resolution action by the PC by means of a CWP HMI function (e.g. free text added to aircraft label) might be helpful.
Category	<Performance>
Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.07.02-OSED-FR04.0243	<Full>
<ALLOCATED_TO>	<Functional block>	C&T	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

A.2.2.2.4.2 System Performance

[REQ]

Identifier	REQ-04.07.02-SPR-FRPC.1102
Requirement	In Free Routing Airspace, the Conflict Detection Tool for PC should inform the controller about all relevant mid-term encounters: • involving at least one distributed flight and • with detected conflict located within the sector area of interest
Title	Mid-term detection of relevant encounters by support tool in FRA
Status	<Validated>
Rationale	In Free Routing Airspace defined at a large geographical scale, sectors cannot be designed to ensure that crossing points are all internal to a sector and far from the sector boundaries. To manage Free Routing operations, the Conflict Detection Tool for PC is essential to support the mid-term detection of encounters. To be efficient, the tool would need to detect all relevant mid-term encounters in the sector area of interest.
Category	<Performance>

Validation Method	<Real Time Simulation>
Verification Method	<Test>

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0001.0023	<Full>
<ALLOCATED_TO>	<Functional block>	CONF	N/A
<ALLOCATED_TO>	<Functional block>	CHMI	N/A
<APPLIES_TO>	<Operational Focus Area>	OFA03.01.03	N/A

A.2.2.2.5 Performance recommendations for Tactical Separation Assurance

No performance recommendation relating to Tactical Separation Assurance for Free Routing operations across ACC/FIR borders within low to medium complexity environments

A.2.2.2.6 Performance recommendations for Ensuring Trajectory Adherence

No performance recommendation relating to Trajectory Adherence monitoring for Free Routing operations across ACC/FIR borders within low to medium complexity environments.

A.2.2.2.7 Performance recommendations for Ground-Based Safety Nets

No performance recommendation relating to Ground-based Safety Nets for Free Routing operations across ACC/FIR borders within low to medium complexity environments.

-END OF DOCUMENT-