SESAR Solution 08.01 Validation Plan (VALP) for V2 - Part I

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PJ08 AAM

ADVANCED AIRSPACE MANAGEMENT

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Abstract

This validation plan describes the V2 validation activities planned for solution 1 of the PJ08 Advanced Airspace Management.

The aim of the planned validation activities in Wave 1 is to complete V2 maturity level of the four Operational Improvements as foreseen in the Transition Validation Strategy [22]:

- AOM-0208- B
- AOM-0805
- AOM-0809A & AOM-0809-B [1]
- CM-0102- B

Model based, fast time simulations and real time simulations are planned to address stakeholders' needs and assess the KPAs

[1] CR 02830 has been submitted to un linked OI AOM-0809-B with the PJ08

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1 Executive Summary

This document details the Validation Plan for PJ08-Solution 01 "Optimised Network Management - Advanced Airspace Management" validation activities for V2 maturity level for SESAR 2020 to be conducted within the time-frame end December 2016 to mid-2019. This Solution addresses the evolution of the Dynamic Airspace Configuration (DAC) concept developed in the previous SESAR 1 and aims at further enhancing the operational processes and automated tools that will support Sector Design and Sector Configurations.

The validation of Solution 08-01 has been designed on a roadmap in two main steps. The first one intends to assess the benefits of DAC and Dynamic mobile areas (DMA) concept elements, and the second step shall focus on examining their operational and technical feasibility. Dynamic Airspace Configuration concept introduces the following new elements:

- Initial performance based approach;
- Dynamic Sectors based on Airspace Building Block and Controlling Building Block airspace design architecture and ARES DMA, BT/MT; Non predefined Sectors Configurations: Airspace Configurations are becoming fully dynamic and define the tool/means of integrated capacity management process of wider DCB process;
- Cross-border Airspace Configurations ;
- Dynamic Mobile Areas of 2 types: DMA type 1 and 2 ;
- Move from collaborative processes to ASM merged with DCB into fully integrated ASM/ATFCM/ATS CDM layered process ;
- The process is not bound by time anymore, but rather by data uncertainty/confidence parameters;
- Automation /system support for integrated Airspace design and management ;
- Enables/support Full Free Route (UPR) operations.

The document identifies the stakeholders and their expectations in terms of OI's and their related enablers, and describes their needs which require a validation focus.

In order to reach V2 for this solution, a total of 6 validation exercises have been planned within the project time-frame. The validation techniques used to address the validation objectives will consist of three model based and fast-time simulations two gaming exercises and one human-in-loop experimentation combining fast and real time simulations. These activities will be carried out using different platforms at different locations and will be based on different geographical areas of interest. This validation plan will assume an incremental approach, in that it will be updated during the life cycle of the project in order to integrate more detailed validation exercise plans which will be produced prior to each exercise. In addition, a Safety Assessment Plan (SAP) and a Human Performance Assessment Plan (HPAP) will also be developed within the project and will be added to the Validation Plan in the form of Annexes, once the output from these activities has reached an advanced stage of maturity.

2 Introduction

2.1 Purpose of the document

This document provides the Validation Plan for the Solution 1 of the PJ08 for V2 maturity level. It describes how stakeholder's needs (defined and formalised as a set of requirements in PJ08 OSED [37] are intended to be validated.

The main objective of the PJ08 Advanced Airspace Management is to provide a Dynamic Airspace Configuration function including Dynamic Mobile Areas (Type 1 & 2) based on improved traffic prediction, to be fully integrated into the DCB processes, and which can be executed as one of the possible processes to adjust capacity in order to meet traffic demand and respond to various performance objectives.

PJ08 shall develop and validate two SESAR Solutions and this document will focus on the:

Solution 1 - **Management of Dynamic Airspace Configurations -** develops the processes, procedures and tools related to Dynamic Airspace Configuration (DAC) management, supporting Dynamic Mobile Areas of Type 1 and Type 2, through:

- En-route ATC sectors' design and configurations principles based on 4D trajectories forecast;
- The activation of Airspace configurations through an integrated collaborative decision making process, at national, sub-regional and regional levels;
- En-route ATC sectors' configurations adapting to dynamic TMA boundaries and both fixed and dynamic elements (i.e. reserved/restricted airspace - ARES, DMA, CBA, CBO).

2.2 Intended readership

This section describes the intended audience:

- PJ08 Members;
- PJ19, as Content Integration Project
- PJ09.01 and PJ09.02 for integration of DAC in DCB, and complexity management
- PJ07.03, for WOC operations on Mission Trajectory Driven Process
- PJ18.01 and PJ18.04, for Network operations on Mission Trajectory
- PJ06.01, for Free Route activities
- SESAR Programme Management
- PJ20, as Master Plan Maintenance project

2.3 Background

The PJ08 is a follow-up of the validation activities performed in the SESAR1 primary project P07.05.04 "Flexible Airspace Management", which are described in detail in D66 Dynamic Airspace Configuration Step 2 V2 Validation Report [38]. In this project, two validation exercises were conducted, and despite the general high-level operational acceptance of the concept by operational staff, refinement of the OSED and further assessments were recommended to prove and further increase maturity of the concept by enhancing the operational processes and automated tools that will support Sector Design and Sector Configurations.

2.4 Structure of the document

The Validation Plan includes the following parts:

- ***VALP – Part I (this volume)***
- VALP – Part II Safety Assessment Plan (SAP)(also attached)
- VALP – Part IV Human Performance Assessment Plan (HPAP) (also attached)

Please note that– Part III Security Assessment Plan (SeAP) is not within scope of VALP (developed within the OSED task).

This document is organised into six sections, outlined as follows, and contains a set of appendices with supplemental information:

- Section 1 presents the Executive Summary;
- Section 2 introduces the document;
- Section 3 explains the overall context of the validation;
- Section 4 develops the approach for the validation for the Solution 1 V2 maturity level;
- Section 5 details the validation plans for each exercise;
- Section 6 presents the references used in this document.

2.5 Glossary of terms

This section defines acronyms specific to this document.

Term	Definition	Source of the definition
Actor	An actor in the context of Air Navigation Service Providers (ANSP) can be an organisation/unit like an ATS unit (ACC,APP, TWR) or an individual like an air traffic controller, planning controller, executive controller etc.	SESAR Integrated Dictionary
Ad-hoc Airspace Structures	Ad-hoc Structures refer to two different concepts: Airspace structures pre-defined at ASM level 1, whose usage is requested at short notice (see	Developed in SESAR 1 Project 07.05.02

Term	Definition	Source of the definition
	definition of Non Pre-coordinated Airspace Structures below) Airspace structures not pre-defined at ASM level 1, and whose creation is requested for a specific temporary purpose.	
Airspace Building Block	Elementary volume of modularised airspace (As defined by the appropriate ANSP) that are too small individually for controlling purposes, but instead form the basic constituent parts of a Controlled Airspace Block as part of an optimising process.	Described in SESAR 1 SWP 7.2DOD
Airspace Configuration	Is a pre-defined and coordinated organisation of routes and their associated airspace structures, temporary airspace reservations and ATC sectorisation.	Described in SESAR 1 SWP 7.2DOD
Airspace Constraint	An Airspace Constraint is a reservation of airspace for activities not linked to a mission trajectory. Examples include ground-to-air or ground-to-ground gunnery sessions. As for any ARES, the activity inside an Airspace Constraint is not shared.	Developed in SESAR 1 Project 07.05.02
Airspace Reservation	Airspace Reservation is a defined volume of airspace temporarily reserved for exclusive or specific use by categories of users.	ASM Handbook EUROCONTROL - GUID – 140
Airspace Restriction	Airspace Restriction is 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’).	ASM Handbook EUROCONTROL - GUID – 140
Airspace Structure	Airspace Structures are specific portions of airspace designed to accommodate the safe operation of aircraft. In the context of the FUA Concept, "Airspace Structures" include Controlled Airspace, ATS Route, including CDRs, ATC Sectors, Danger Area (D), Restricted Area (R), Prohibited Area (P),	ASM Handbook EUROCONTROL - GUID – 140

Term	Definition	Source of the definition
	Temporary Segregated Area (TSA), Temporary Reserved Area (TRA), Cross-Border Area (CBA)…	
Airspace User	Airspace user means civil or military aircraft operating in the air as well as any other parties requiring airspace. The term “airspace users” mainly refers to the organizations operating aircraft including rotorcraft, and their pilots. Three classifications of airspace users are considered: ICAO-compliant manned flight operations (the largest segment by far): ICAO-compliant manned flight operations are those conducted in accordance with ICAO provisions (e.g. SARPs, PANS). ICAO-compliant airspace users include: all civil aircraft operators engaged: in commercial air transport -scheduled and non-scheduled (passenger transport, mail and cargo services, emergency medical services, etc...), in business and general aviation: air taxi operators, aerial work, private air transport, sporting and recreational aviation, etc... ; and the portion of State users operating State aircraft using civil air traffic rules (GAT) ICAO non-compliant manned flight operations: ICAO non-compliant manned flight operations are those which cannot comply for operational or technical reasons (e.g.: conducted by State aircraft -OAT-) Flight operations of unmanned aerial systems (UASs): Flight operations of unmanned aerial systems (UASs), a growing segment of airspace users, include both civil and military applications of UAV technology	Reg. 2150/2004 (definition of ‘users’) SWP 7.2 DOD (version 00.00.15)
Business Trajectory	A 4D trajectory which expresses the business intentions of the user with or without constrains. It includes both ground and airborne segments of the aircraft operation (gate-to-gate) and is built from, and updated with, the most timely and accurate data available.	Detailed in SESAR 1 P11.01.01 Transversal consistency of BT/MT requirements (across WPs) D11.01.01-1 Definition of trajectory requirements for Step 1, including gap

Term	Definition	Source of the definition
		analysis, support to standardization report from Airspace Users perspective
Calculated Take-off Time (CTOT)	An Air Traffic Flow & Capacity Management (ATFCM) departure slot, forming part of an Air Traffic Control (ATC) clearance, which is issued to a flight affected by Network Management regulations. It is defined by a time and tolerance (-5 to +10 minutes) during which period the flight is expected to take-off.	ICAO Doc 7030/4 – EUR D11.01.01-1 Definition of trajectory requirements for Step 1, including gap analysis, support to standardization report from Airspace Users perspective
Controlled Airspace Block	A Controlled Airspace Block (replacing the current predefined elementary sectors) is a section of modularized airspace within which a Tactical Air Traffic Controller performs his controlling functions defined as a result of dynamic airspace configuration process. Controlled Airspace Blocks are created as a result of a dynamic airspace configuration process in which each controlled block is an optimised grouping of Airspace Building Blocks under consideration of the forecast traffic pattern and ATCO availability and Safety/Performance metrics. The Controlled Airspace Block forms the elementary size of a "Hotspot Unit."	SWP 7.2 DOD
Controlled Time of Arrival (CTA)	An ATM imposed time constraint on a defined merging point associated to an arrival runway.	SESAR Conops
Controlled Time Over (CTO)	An ATM imposed time constraint over a point.	SESAR Conops
Critical Events	Critical Event. An unusual situation or crisis involving a major loss of EATMN capacity, or a major imbalance between EATMN capacity and demand, or a major failure in the information flow in one or several parts of EATMN.	EUROCONTROL DNM
	Critical event refers to a sudden and usually unforeseen event leading to a high drop in network capacity and a potential crisis situation, involving many partners and requiring immediate action to minimize consequences and to retrieve network stability. The management	Detailed in SESAR1 SWP 7.2 Step1 DOD Final

Term	Definition	Source of the definition
	of critical events may be mostly reactive (unplanned). Real time information sharing will help the different partners to assess the situation, to take appropriate and coordinate actions at their levels and to provide support to the Crisis Coordination Cell.	
DAC actor	DAC actor within this OSED refers to composition of responsibilities for carrying out of main DAC management related tasks and activities associated with DAC management processes at Local or Sub regional levels which include DAC planning, assessment, negotiation, publication and sharing, decision making and implementation.	Newly defined term in the project.
Deployment Baseline	The Deployment Baseline consists of operational and technical solutions that have successfully completed the R&D phase and have been implemented or are being implemented. Additional Note: The Deployment Baseline encompasses the current baseline (what exists today), augmented by the Operational Improvements of the former "IP1" (Implementation Package 1). The Deployment Baseline precedes SESAR Step 1.	Master Plan 2012 update
Dynamic mobile area (DMA)	Dynamic Mobile Area (DMA) is temporary volume of airspace designed to separate the activities performed inside from the air traffic. These exclusion volumes are dynamically mobile with the aim to minimise the impact on the network Dynamic Mobile Areas while satisfying specific AU operational requirements, encompassing civil, state and military flights engaged in activities that require such reservation. There are two types of DMA that have been identified for Step 2: DMA Type 1 is a volume of airspace of defined dimensions as integral part of MT at flexible geographical locations agreed upon a CDM process, satisfying Airspace Users requirements in terms of a time and/or distance constraint parameters from a reference point as specified by AU (e.g. Aerodrome of Departure). DMA2: is a volume of airspace of defined dimensions described as integral part of MT and agreed upon a CDM process, satisfying the	SESAR Concept Of Operations Step 2 Edition 2014, Del ID D105, version 01.01.00

Term	Definition	Source of the definition
	Airspace Users requirements in terms of volume, position and duration. This volume of airspace can be planned and used at any geographical location along a trajectory.	
Early Flight Intents	Early flight intents are a set of data provided by an Airspace User to express its intentions to use the airspace. This set of data includes a first level of trajectory description.	
Flight Intents	The future aircraft trajectory expressed as a 4-D profile until destination (taking account of aircraft performance, weather, terrain, and ATM service constraints), calculated and “owned” by the aircraft flight management system, and agreed by the pilot.	ICAO Doc 9854
Flight Operation Centre (FOC)	Flight Operation Centre is a part (department, employee) of an Airspace user or a system used by an Airspace user providing FOC services and support like operational control, flight planning, pre-flight briefing, in-flight support and post-flight analyses in accordance to AU’s Operational Manual and Standard Operational Procedures.	P11.01.01 Transversal consistency of BT/MT requirements (across WPs) D11.01.01-1 Definition of trajectory requirements for Step 1, including gap analysis, support to standardization report from Airspace Users perspective
Forecast Business Trajectory	4D definition of the trajectory associated with a level of uncertainties which evolved according to the time horizon. The FBT uncertainties are characterised by Time uncertainty, Lateral uncertainty, Vertical uncertainty. The purpose is to elaborate the best predictable 4D Trajectory representation called Forecast Business Trajectory (FBT) using uncertainty modelling and including result on FBT itself. The FBT shall be built from historical data (statistical model) and various database (Airport, AO, …), then the FBT shall be refined all along the timeline based on SBT (2D + schedule or 3D + schedule or 4D profile), and trajectory elements that will be known only at a later stage of the planning process (information on 4D route, Constraints …) FBT will be complemented by prediction algorithms and simulation tools used to anticipate flight intentions which are not yet	

Term	Definition	Source of the definition
	known at the considered anticipated time (SBT maturity, weather conditions, etc.)	
Full Operational Capability (FOC)	It is the date at which a given capability is sufficiently deployed to provide its first benefits.	
Hotspot	Where the estimated ATC workload exceeds an established acceptable threshold.	Defined in SESAR 1 P13.2.3 project
Imbalance	Imbalance between Demand and Capacity (measured by the occupancy rate in a Controlled Airspace Block)	Defined in SESAR 1 P13.2.3 project
Improved OAT Flight Plan	A flight plan based upon the ICAO 2012 FPL format, improved with initial Mission Trajectory data and harmonised military information items, managed centrally at European level and used by military organisations operating IFR in European airspace.	Project 07.06.02 OSED Step 1 V3 Volume 2
Initial Operational Capability (IOC)	It is the date of first deployment of a given capability.	Defined in SESAR 1 P7.5.4
Interoperability	The condition achieved among communications-electronics systems or items of communications-electronics equipment when information or services can be exchanged directly and satisfactorily between them and/or their users. The degree of interoperability should be defined when referring to specific cases.	DOD Dictionary of Military and Associated Terms 08 November 2010
Major Events	Examples of Major Events include: large scale military exercises, Chief of States Summit, Olympic Games, Football World Cup, etc.	SWP 7.2 DOD
Network Operations Plan (NOP)	[NOP consists of]: a set of information and actions derived and reached collaboratively 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, 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. It supports and reflects the result of the collaborative ATM planning process: at each phase, stakeholders collaborate at developing a common view of the planned network situation,	SWP 7.2 DOD

Term	Definition	Source of the definition
	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.	
Revision of the Reference Business or Mission Trajectory	The revision of the Reference Business or Mission Trajectory (RBT/RMT) is triggered at Controller or Flight crew initiative when there is the need to change the route and/or altitude constraints and/or time constraints, mainly due to hazards (traffic, weather), fine sequencing (CTA or CTO allocation) or inability for the aircraft system to meet a constraint (CTA missed).	SESAR Conops
Sortie	A sortie is a combat mission of a military aircraft starting when the aircraft takes off and ending on its return.	
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.	(source ATM lexicon)
System Wide Information Management	[SWIM consists of] standards, infrastructure and governance enabling the management of ATM information and its exchange between qualified parties via interoperable services.	SESAR Integrated Dictionary
Temporary Segregated Area (TSA)	Temporary Segregated Area (TSA) is a defined volume of airspace normally under the jurisdiction of one aviation authority and temporarily segregated, by common agreement, for the exclusive use by another aviation authority and through which other traffic will not be allowed to transit. In the context of the FUA Concept, all TSAs are airspace reservations subject to management and allocation at ASM Level 2.	European Route Network Improvement Plan (ERNIP), Part 3 - The ASM Handbook
Temporary Reserved Area (TRA)	Temporary Reserved Area (TRA) is a defined volume of airspace normally under the jurisdiction of one aviation authority and temporarily reserved, by common agreement, for the specific use by another aviation authority and through which other traffic may be allowed to transit, under ATC clearance. In the context of the FUA Concept, all TRAs are airspace reservations subject to management and allocation at ASM Level 2.	European Route Network Improvement Plan (ERNIP), Part 3 - The ASM Handbook

Term	Definition	Source of the definition
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).	(source ATM lexicon)
	Note : The Reference Business or Mission Trajectory (RBT/RMT) is the last instantiation of the SBT/SMT. It is associated to the filed flight plan and includes both air and ground segments. It consists of 2D routes (based on published way points and/or pseudo waypoints computed by air or ground tools to build the lateral transitions and vertical profiles); altitude and time constraints where and when required; altitude, time and speed estimates at waypoints, etc. When an RBT/RMT is agreed a NOP update is triggered.	(source SESAR Definition phase)
Unplanned Events	Ad-hoc, non nominal situations that happens without any advance pre-notification	Newly defined term in the project.
Update of the Reference Business or Mission Trajectory	The update of the Reference Business or Mission Trajectory (RBT/RMT) is automatically triggered when the trajectory predictions continuously computed by the aircraft system, differ from the previously shared trajectory predictions more than the delta defined by ATC in Trajectory Management Requirements (TMR). The update of the RBT/RMT can also be triggered on request or periodically.	SESAR Def Phase
Wing Operations Centre	The WOC is a generic term, which gathers the operational processes and services directly related to the airspace users and linked to Mission Trajectories and other aerial activities. This definition avoids detailing the diverse organisational structures existing in Europe. It is the Military equivalent to the civil Flight Operations Centre (FOC)	P11.01.01 Transversal consistency of BT/MT requirements (across WPs) D11.01.01-1 Definition of trajectory requirements for Step 1, including gap analysis, support to standardization report from Airspace Users perspective
What-if tools	"What-If" re-routing simulations allow selecting a single flight and perform re-route trials using flight route alternatives provided by the system, so that the delay imposed on this single flight is minimized and there is no overload on the traffic volumes crossed by the re-route flight.	

Term	Definition	Source of the definition
	The system automatically provides the benefit and overload, and also automatically calculates and displays the EET and route length differences between the original flight route and the provided flight route alternatives.	

Table 1: Glossary of terms

2.6 Acronyms and Terminology

Term	Definition
AAMS	Advanced Airspace Management System
ABB	Airspace Building Block
ACC	Area Control Centre
ADD	Architecture Definition Document
ADU	Air Defence Unit
AFUA	Advanced Flexible Use of Airspace
AIP	Aeronautical Information Publication
AMC	Airspace Management Cell
AMT	Airspace Monitoring Tool
AN	Availability Note
ANSP	Air Navigation Service Provider
AO	Aircraft Operator
AOM	ATM Organisation and Management
APW	Area Proximity Warning
ARES	Airspace Reservation/Restriction
ASM	Airspace Management
ATFCM	Air Traffic Flow and Capacity Management
ATC	Air Traffic Control

Term	Definition
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATM MP	Air Traffic Management Master Plan
ATS	Air Traffic Services
ATSU	ATS unit
ARN	ATS Route Navigation
AU	Airspace User
AUA	ATC Unit Airspace
AUP	Airspace Use Plan
BT	Business Trajectory
CAB	Controlled airspace block
CBA	Cross-Border Areas
CBO	Cross-Border Operations
CDM	Collaborative Decision Making
CDR	Conditional Route
CFMU	Central Flow Management Unit
CIAM	CFMU Interface for Airspace management
CM	Conflict Management
CONOPS	Concept of Operations
CPDLC	Controller Pilot Data Link Communications
CQZ	Controllers Qualification Zone
CTA	Control Area
CTA	Controlled Time of Arrival
CTO	Controlled Time Over
CTR	Control Zone
CWP	Controller Working Position

Term	Definition
DAC	Dynamic Airspace Configuration
DCB	Demand Capacity Balancing
dDCB	Dynamic DCB (Demand Capacity Balancing)
DFL	Division Flight Level
DMA	Dynamic Mobile Area
DOD	Detailed Operational Description
DOW	Description of Work
EATMA	European ATM Architecture
eAUP	electronic Airspace Use Plan
EC	European Commission
E-ATMS	European Air Traffic Management System
E-OCVM	European Operational Concept Validation Methodology
EPP	Extended Projected Profile
ES	Elementary Sector
ETO	Estimated Time Over
EUROCAE	European Organisation for Civil Aviation Equipment
FAB	Functional Airspace Block
FBT	Forecast Business Trajectory
FDPS	Flight Data Processing System
FIR	Flight Information Region
FMP	Flow Management Position
FRA	Free Route Airspace
FOC	Flight Operations Centre
FUA	Flexible Use of Airspace
GAF	German Air Force
GAT	General Air Traffic

Term	Definition
HIL	Human-in-the-Loop
HLAPB	High Level National / Sub-regional Airspace Policy Body
IBP	Industrial Based Platform
ICAO	International Civil Airspace Organisation
IFR	Instrument Flight Rules
IRS	Interface Requirements Specification
I-4D	Initial 4D Trajectory
INTEROP	Interoperability Requirements
KPA	Key Performance Area
KPI	Key Performance Indicator
MET	Meteorological Service
MT	Mission Trajectory
MTCD	Medium Term Conflict Detection
MVPA	Military Variable Profile Area
NIMS	Network Information Management System
NMF	Network Management Function
NOP	Network Operations Plan
NSA	National Supervisory Authority
NWP	Network Working Position
OAT	Operational Air Traffic
OCD	Operational Concept Description
OFA	Operational Focus Areas
OI	Operational Improvement
OSED	Operational Service and Environment Definition
PIR	Project Initiation Report
PIRM	Programme Information Reference Model

Term	Definition
PT	Predicted Trajectory
RBT	Reference Business Trajectory
RMT	Reference Mission Trajectory
SAM	Sharable airspace module
SBB	Sector building block
SBT	Shared Business Trajectory
SMT	Shared Mission Trajectory
SES	Single European Sky
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 Air Traffic Flow and Capacity Management Measures
SUT	System Under Test
SWIM	System Wide Information Management
SWP	Sub-Work Package (within the SESAR Programme) – Sub-division of a Work Package; divided into Projects
TAD	Technical Architecture Description
TMA	Terminal Area
TMRs	Trajectory Management Requirements
TRA	Temporary Reserved Area
TRL	Technology Readiness Level
TRM	Trajectory Management
TSA	Temporary Segregated Area

Term	Definition
TS	Technical Specification
TTA	Target time of arrival
TTO	Target time over
UAS	Unmanned Airborne Systems
UAV	Unmanned Aerial Vehicle
UDPP	User Driven Prioritisation Process
UIR	Upper Information Region
UPR	User Preferred Routing
UPT	User Preferred Trajectory
UC	Use Case
UUP	Updated Airspace Use Plan
VALP	Validation Plan
VALR	Validation Report
VALS	Validation Strategy
VFR	Visual Flight Rules
VP	Verification Plan
VPA	Variable Profile Area (a design principle)
VPN	Virtual Private Network
WOC	Wing Operations Centre
WP	Work Package (within the SESAR Programme) – divided into SWPs (Sub Work Packages)

Table 2: Acronyms and terminology

3 Context of the Validation

This section describes the context for the Validation Plan per V2 phase that will be detailed in section 5.

3.1 Validation Plan context

The validation of the Solution 08.01 is planned in a two steps approach:

- The first one will focus on the performance assessment of the DAC including DMA concept elements, in terms of related KPIs. This will be done through three exercises, known as EXE-08.01-V2-VALP-001, EXE-08.01-V2-VALP-004 and EXE-08.01-V2-VALP-005 by model based and fast time simulations.
- The second one will determine the operational feasibility of the DAC concept elements, from the regional, sub regional level to the ATCOs. This will be done through two gaming exercises and one HIL experimentation known as EXE-08.01-V2-VALP-002, EXE-08.01-V2-VALP-006 and EXE-08.01-V2-VALP-003 which will mainly focus on the different actors like ATCOs, FMPs, Airspace designers and Military.

This approach will allow, at the end of the Wave 1, to move from Collaborative processes to Airspace Management integrated with DCB into ASM/ATFCM/ATS CDM layered process. Integrated exercises between PJ08 and PJ09 are intended to be addressed in Wave 2.

All these exercises will be carried out in a Free Route environment within the Core Area airspace (MILANO ACC, MUAC ACC, MADRID ACC, etc.). More detailed information on this can be found in part 5 of this document.

3.2 SESAR Solution 08.01: a summary

This validation plan focuses on the SESAR Solution PJ08-01: Management of Dynamic Airspace Configuration. This solution addresses the evolution of the Dynamic Airspace Configuration (DAC) Concept developed in SESAR 1, to prove and further increase its maturity by enhancing the operational processes and automated tools that will support Sector Design and Sector Configurations. The definition of a new generation of Airspace Reservations (ARES) as part of or independent from the trajectory, the Dynamic Mobile Areas of Type 1 and Type 2, is refined; the data model is addressed as well as related performance and operational feasibility.
The DAC concept, including AFUA workflows related to DAC planning and execution phases, is elaborated and enhanced by validation exercises supported by more complete performance measurements, and on larger geographical areas.
Two models, known as Model A “Partially Distributed DAC Management Model” and Model B “Fully Distributed DAC Management Model”, have been defined in the OSED[37] to achieve an optimised configuration for a defined airspace, based on the forecast workload/complexity level trajectories, new types of ARES and ATCO availability in respect of defined performance targets to be achieved or examined (e.g. airspace configuration aiming to improve flight efficiency or capacity).

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)	*Develop v Uses	*Required v Optional
SESAR Solution 08.01	Management of Dynamic Airspace Configurations	M	**Solution 08.01 focus on validation of Dynamic Airspace Configurations (DAC) and Dynamic Mobile Areas (DMAs) of types 1 and 2 in FRA that enable flexible solutions that can be dynamically adapted to traffic demand to respond to different regional/local performance objectives, which may vary in time and place up to concept maturity level 2**	**AOM-0208-B**			
					AAMS-16a	Uses	R
					AIMS 15	dev	R
					ER APP ATC 80	Dev	R
					NIMS-14b	Uses	O
					NIMS-14c	Uses	O
					NIMS-19	Uses	O
					PRO-146	Dev	O
				AOM-0805	AAMS-13	Dev	R
					AAMS-12	Uses	R
					ER APP ATC 15	Uses	R
					ER APP ATC 80	Dev	R
					AIMS-04	UseS	R
					AIMS-22	Uses	R
					AIMS-23	Uses	R
					METEO-05c	Uses	O
					NIMS-04	Dev	R
					NIMS-30	Uses	R
					PRO-010	Uses	O
					AAMS-13	Dev	R

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)	*Develop v Uses	*Required v Optional
				AOM-0809 B[2]	AIMS-22	Uses	R
					METEO-05c	Uses	O
					NIMS - 04	Dev	R
					–		
				AOM-0809 A	AAMS 12	Dev	R
					NIMS 30	Uses	R
					PRO10	Uses	O
				CM-0102-B	AIMS-23	Uses	O
					METEO-05c	Uses	O
					AAMS 19	Dev	R

Table 3: SESAR Solution(s) under Validation

**Although not required by EATMA, the project has identified the enablers that will be developed during the project's lifecycle and those which will be used during the validation activities..*

As defined in the Grant Agreement, the AOM 206B will not be addressed in the Solution 1.

3.3 SESAR Solution 08.01: Key R&D Needs

The solution under 08.01 will further develop the R&D work carried out already within the scope of P07.5.04.

[2] CR 02830 has been submitted to unlink OI AOM-0809-B with PJ08

There is a need to ensure that the DAC/DCB is fully integrated into the dynamic management of European airspace and able to provide optimum capacity, while maintaining a high level of safety. To enable this, the design principles in terms of airspace, sector configuration and tools need to be further refined at all DAC levels and optimal use of human resources needs to be ensured, using both centralised and distributed DAC management models. The solution is also expected to provide performance related data in terms of cost-efficiency through a CBA, to demonstrate that it can deliver the required benefits.

The refined airspace design tools, sector configuration tools and sector opening scheme optimizers should support the configuration sequence workability of DMA type 1 and 2 at regional, sub-regional and local levels. In addition, the roles and responsibilities of the actors involved, which include the airspace designers, airspace managers and ATCO's need to be clearly defined within the DAC/DCB environment, with confirmation of operational acceptability.

The solution should also be able to demonstrate that, through an integrated management process, the availability of new automated tools supports the effective and secure exchange of information between joint civil/military activities.

To ensure the integration of the concept in a seamless ATM process, a common approach in addressing elements such ATC, DCB and FRA with other projects needs to be adopted (for example PJ09)

3.4 Validation Targets apportioned to the SESAR Solution

The TVALS [22] describes the KPA's that have been targeted for the Solution 08.01.

The table below lists them, taking into account the Performance Framework REF _Ref485884441 \r \h [39]

KPA Focus Area	KPI/PI	Trend		Expectation	
Safety (ATM system safety outcome)	SAF (SAF1.9)	→	M	Advanced Airspace Management should ensure that safety standards will not be downgraded enabled by automated support tools and may be improved through an increased common situational awareness at sub-regional and regional levels.	
Environment	ENV-(FEFF1,FEFF2 & FEEF3)	↗	M	Optimisation of flight trajectories and profiles will reduce fuel burn, noise and CO2 emissions. Advanced Airspace Management should decrease Airspace Users fuel consumption and reduce flight time.	
Capacity (Airspace Capacity)	CAP (CAP2)	↗	H	Airspace Capacity: Advanced Airspace Management allows a better use of available ATC capacity and a better balancing of ATC workload leading to reduced demand/capacity imbalance.	

KPA Focus Area	KPI/PI	Trend		Expectation
Predictability (G2G variability in flight duration)	PrD (PRD1)	↗	M	Advanced Airspace Management allows an optimised use of airspace that supports both the civil and military preferred trajectories.
Human Performance	HP1-4	↗	H	Human Performance: the incorporation of enhanced Complexity Management and more efficient traffic forecast optimise airspace configuration ensuring a better balancing of ATC workload.
Cost efficiency(G2G ANS cost efficiency)	CEF (CEF2)	↗	H	Direct cost of NM & of Local Tool: Advanced Airspace Management supported by SWIM/NOP Information Platform will contribute to reduce maintenance and development costs for the Network Manager and local service providers by reducing the number of different remote HMI applications (through implementation of one stop shop access) and by streamlining assets through use of uniform service-oriented principles. Local tools will benefit from the provided SWIM services through easy connectivity to NM and by means of a convenient and economical way to exchange information with the Network. Cost of Air Navigation: Advanced Airspace Management allows improved ATM resource planning and better use of existing capacities leading to reduced ATC and Airport Capacity costs.
Flexibility	FLX1, FLX4	↗	H	Advanced Airspace Management allows increasing the flexibility of airspace configurations to adapt to any change of demand pattern or unexpected change of users trajectory intents. It shall also allow acceptance by ATM system of military short-term request for mission planning/execution in accordance with priority rules.
Civil-Military Cooperation and Coordination(impact of ATM on military operation and training activities, and Contribution to Civil ATM performance)	CMC (1.1, 1.2, 1.3, 2.1, 2.2)	↗	H	Advanced Airspace Management enables the accommodation of military operational and training needs while safeguarding the required level of military mission effectiveness.

Validation Targets have been defined by[42] and are shown in the Table below. It should be also noted that RES and SAF have no validation targets defined, as they have been considered to be a design goal (baseline level to be preserved).

KPA	Sub-Operating Environment FRA	Sub-Operating Environment FRA	Sub-Operating Environment FRA
En Route Capacity	1.79%	1,79%	0,717%
Cost Efficiency	0.29%	0,085%	0,149%
Environment (fuel efficiency)	3.06%	0,875%	0,919%
Civil and Military Collaboration and Coordination	No target	No target	No target
			-6.09%

Table 4: Validation Targets apportioned to the SESAR Solution

3.5 Initial and Target Maturity levels

Taking data set DS18a as a reference the following table lists the maturity levels of the SESAR ATM Solutions 08-01 addressed by the Project.

SESAR Solution	OI Steps	Initial Maturity level	Target Maturity level	Reused validation material from past R&D Initiatives
SESAR Solution PJ08-01: Management of Dynamic Airspace Configurations	AOM-0208-B	Initial V2	V2	End of V1, partly V2 following the Final SESAR 1 Maturity Assessment Report Executive Summary
	AOM-0805	Initial V2	V2	End of V1, partly V2 following the Final SESAR 1 Maturity Assessment Report Executive Summary
	AOM-0809-A	Initial V2	V2	End of V1, partly V2 following the Final SESAR 1 Maturity

				Assessment Report Executive Summary
	AOM-0809-B	Initial V1	V1	New OI, from the split of AOM-0809
	CM-0102-B	Initial V2	V2- on going	End of V1, partly V2 following the Final SESAR 1 Maturity Assessment Report Executive Summary

Table 5: Maturity levels table

4 SESAR Solution Validation Plan for V2

4.1 SESAR Solution 1 Validation Approach for V2

The V2 maturity level will be addressed through an incremental approach of assessments.

The EXE-08.01-V2-VALP-001, EXE-08.01-V2-VALP-004 and EXE-08.01-V2-VALP-005 will contribute to the performance assessment of the DAC and DMAs, to justify the benefits and to contribute to the CBA. These three exercises will consist of model based and fast time simulations (FTS), based on MUAC and ENAV and Bordeaux and Aix French ACCs. The main focus of these three exercises will be to mainly assess the KPAs and KPIs.

The EXE-08.01-V2-VALP-002 and EXE-08.01-V2-VALP-006 will evaluate the feasibility, from a technical and operational point of view of the concept elements, in an incremental manner, with a particular focus on the role and responsibilities, support needed, etc. of the different actors (ASM, FMP, ATCO….) These two validation exercises will be performed through gaming platforms. The results of these exercises should allow the refinement of the tools/architecture requirements and will provide feedback to the OSED.

Finally the EXE-08.01-V2-VALP-003 will integrate the results of the previous experiments and with a robust HP assessment, through a fast time and real time simulation, will assess the operational feasibility of the concept, and also strive to ensure the integration of the concept with other projects (like PJ09).

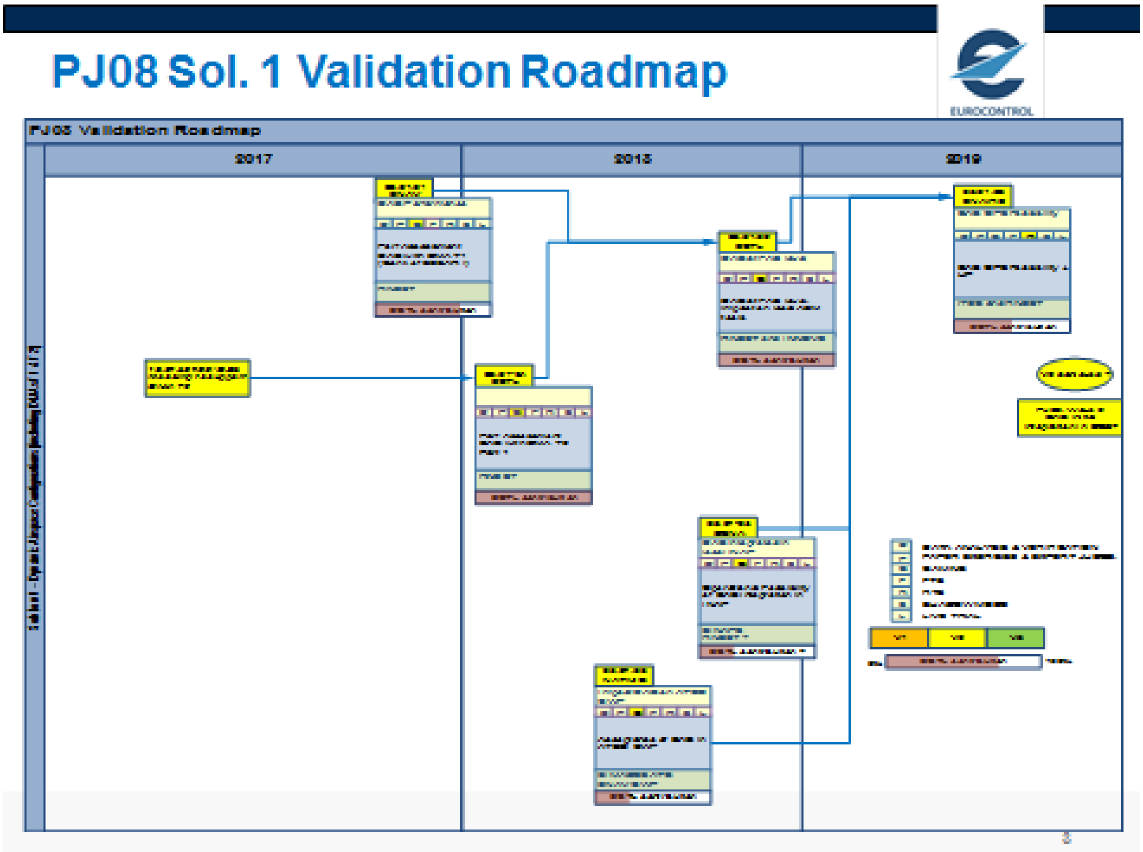

Figure 1: Validation roadmap

4.2 Stakeholder's expectations

Stakeholder	Involvement	Why it matters to stakeholder
European Network Manager	Direct involvement, as part of the concept team, and will be part of the gaming validations	Wish to ensure effective cooperation between all the stakeholders in moving towards an optimised airspace configuration. Need to ensure feasibility of the tools and procedures to support collaborative and coordinated layered planning and execution processes in Network management activities. Would like to see improved efficiency through ATFCM/ASM integration. Interested in assessing the impact of military activities on the Network capacity through improved management of available airspace and coordination between military authorities and airspace users.
Airspace Users	No direct involvement in the validation. However, interested in the outcome.	Interested in achieving fuel efficiency. Interested in the flexible use of airspace on a day-to-day basis.
ANSPs	Actors in the validation activities. Participating in definition and refinement of concept, providing requirements, leading or contributing to some of the validation exercises and providing ATM expertise.	Interested in the optimised use of airspace and wish to increase airspace capacity and safety Wish to assess cost efficiency through optimum use of available human resources. Need to ensure that the roles and responsibilities of the ATCO's with regard to concept are clearly defined. Want to evaluate that the appropriate tools and automated support and procedures used to optimise the airspace configuration are provided.
Military Airspace Users	Actors in the validation activities Participation in definition and refinement of DAC concept, provide	Flexible and effective access to airspace by relying on the responsiveness of airspace management. The need for civil/military coordination through effective and secure exchange of information

	requirements, participation in exercises	(collaborative decision making in planning and execution). Performance improvements to civil stakeholders will potentially lead to military flight and operational efficiency improvements. Enhanced interoperability between civil and military communications / navigation / surveillance ground and airborne capabilities.
European Commission	Direct participation through SJU	The EC is particularly interested in the KPA's which involve capacity, efficiency, flexibility and predictability.

Table 6: Stakeholders' expectations

4.3 Validation Objectives

This section provides the list of validation objectives defined for the SESAR Solution 08.01 for the V2 maturity level phase. These validations objectives are High Level ones and will be further detailed in Part 5 by each exercise.

The Operating Environment Categories (OEs) related to PJ08.01 solution are [41]

Primary Categories (OEs)	"Network"	"En-route"
Description of primary categories (OEs)	Entirety of all OEs ("En-route", "Terminal", and "Airport") including also airspace users and other stakeholders (e.g. MET, etc.)	An ATC operational unit providing Area Control Services in a part of the airspace under control
Classification criteria of primary categories (OEs)	-	Aggregated Traffic Complexity Score (or annual number of IFR flights)

High Level Validation Objectives have been regrouped in four groups, for better readability:

- Performance related (PE1)
- Technical feasibility (TF1)
- Operational feasibility (OF1)

- Compatibility with other projects. (CO1)

[OBJ]

Identifier	OBJ-08.01-V2-VALP-PE1
Objective	To Assess High Performance benefits from Dynamic Airspace Configurations
Title	Performance Assessment
Category	<performance>
Key environment conditions	Nominal conditions, Traffic sample 2023 , Dense traffic Area High and Medium Complexity, Free Route
V Phase	V2

[OBJ Trace]

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[OBJ Suc]

Identifier	Success Criterion
CRT-08.01-V2-VALP-PE1-001	Solution 08.01 increases (2,96%, Validation Target) en-route capacity in nominal conditions under Free Route Airspace

Identifier	Success Criterion
CRT-08.01-V2-VALP-PE1-002	Solution 08.01 increases Predictability (0,47%, Validation Target) of the flight duration variability)
CRT-08.01-V2-VALP-PE1-003	Solution 08.01 increases Cost Efficiency (0,53%, Validation Target) of the flight per ATCO hours
CRT-08.01-V2-VALP-PE1-004	Solution 08.01 maintains the current level of Safety (no target)
CRT-08.01-V2-VALP-PE1-005	Solution 08.01 has a positive impact on Environment (fuel efficiency, no target)
CRT-08.01-V2-VALP-PE1-006	Solution 08.01 has a positive impact on Civil and Military Collaboration and Coordination (no target)

[OBJ]

Identifier	OBJ-08.01-V2-VALP-TF1
Objective	To Assess Technical Feasibility of DAC and DMAs concept
Title	Technical Feasibility
Category	<technical feasibility>, < tool usability>
Key environment conditions	Nominal conditions, Traffic sample 2023, Dense traffic Area High and Medium Complexity, Free Route
V Phase	V2

[OBJ Trace]

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[OBJ Suc]

Identifier	Success Criterion
CRT-08.01-V2-VALP-TF1-001	Solution 08.01 develops or at least defines requirements for tools to support the actors activity
CRT-08.01-V2-VALP-TF1-002	Solution 08.01 provides evidence of the usability of automated support for the decision making process assessing and comparing different airspace configurations based on complexity.
CRT-08.01-V2-VALP-TF1-003	Solution 08.01 provides evidence of the usability of automated support to monitor automatically the implemented solutions based on dynamic airspace management.

[OBJ]

Identifier	OBJ-08.01-V2-VALP-OF1
Objective	To Assess Operational Feasibility of DAC and DMAs concept
Title	Operational Feasibility
Category	<Operational feasibility>, < human performance>
Key environment conditions	Nominal conditions, Traffic sample 2023, Dense traffic Area High and Medium Complexity, Free Route
V Phase	V2

[OBJ Trace]

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[OBJ Suc]

Identifier	Success Criterion
CRT-08.01-V2-VALP-OF1-001	Solution 08.01 provides evidence of the human capability to successfully accomplish tasks and meet job requirements.
CRT-08.01-V2-VALP-OF1-002	Solution 08.01 develops operational procedures, identifies the different roles of the actors involved.
CRT-08.01-V2-VALP-OF1-003	Solution 08.01 provides evidence of good rate of acceptability of the concept proposed by the different actors involved

[OBJ]

Identifier	OBJ-08.01-V2-VALP-C01
Objective	To Assess the Compatibility of the concept with other projects
Title	Compatibility
Category	
Key environment conditions	Nominal conditions, Traffic sample 2023, Dense traffic Area High and Medium Complexity, Free Route
V Phase	V2

[OBJ Trace]

Relationship	Linked Element Type	Identifier
<COVERS>	<SESAR Solution>	SESAR Solution 08.01
<COVERS>	<Sub-Operating Environment>	ER HC
<COVERS>	<Sub-Operating Environment>	ER MC
<COVERS>	<Validation Target>	Validation Target 1 identifier
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<COVERS >	<HL Obj>	OBJ-PJ0801-VALST2.003
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[OBJ Suc]

Identifier	Success Criterion
CRT-08.01-V2-VALP-CO1-001	Solution 08.01 provides evidence of Operational feasibility of the concept and performance benefits when the concept is integrated into the in the Free-Route environment.
CRT-08.01-V2-VALP-CO1-002	Solution 08.01 develops relationships between dynamic airspace configuration concept and DCB concept
CRT-08.01-V2-VALP-CO1-003	Solution 08.01 develops relationships between ARES (DMA types 1 and 2) allocation management concept with the Business and Mission Trajectory, Free Routing and DCB concepts

Table 7: Validation Objective layout

Please note that a “cover” link has been added in the Template, in order to ensure the compliance with EOCVM by tracing the link between HL validation Objectives (as described in Transition Validation Strategy [22]) and the Validation Plan Objectives.

4.4 Validation Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
PJ08-A#1	Environment constraints		Weather is not taken into account. The exercise will consider operations in nominal conditions	V2 maturity level, in planning phase	Planning phase	ENV SAF HP				
PJ08-A#2	Workload integrated in DAC design		A predicted workload calculation method is required in the design of the DAC algorithm, in order to efficiently create sectorisation balancing the workload.		Planning phase	HP SAF	Pj08 OSED		Pj08 OSED	
PJ08-A#3	Free Route		Free Route is safe, validated and implemented		Planning phase	ENV FEFF SAF HP	PJ08 OSED		PJ06	
PJ08-A#4	Mission Trajectory		DMA are part of the mission trajectory, this concept is validated		Planning phase		PJ08 OSED		PJ07	

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
			and implemented. For the purpose of the exercises, DMA will be described as in the PJ08 OSED							
PJ08-A#5	Alternative Routes		Flights that are re-routed will take the shortest path		Planning and Execution Phase	CAP SAF ENV FEFF	PJ08 OSED		PJ08 OSED	

This section will be defined further, when the exercise plans will be available.

Table 8: Validation Assumptions overview

4.5 Validation Exercises List

4.5.1 EXE-08.01-V2-VALP-001

Identifier	EXE-08.01-V2-VALP-001
Title	DAC Performance
Description	The exercise will focus on Dynamic sectorisation + DMA type 1 performance assessment in FRA through a model based experiment using R-NEST simulator to compute optimum sector design and sector opening scheme using high level workload/complexity assessment function and consistent capacity metric for the full DAC process.

Expected achievements	Improvement of fuel efficiency, cost effectiveness and en Route capacity. Confirmation of the Technical feasibility of sector design and dynamic airspace configuration algorithms for the full DAC process, starting from airspace design to dynamic configuration management. Initial conclusions on operational and technical feasibility of DMA-type 1 design principles integrated into DAC for a defined area of Italian Airspace.
V Phase	<V2>
Use Cases	<UC2><UC3><UC5> from the SPR-INTEROP/OSED
Validation Technique	Fast time simulation, judgemental analysis
KPA/TA Addressed	Fuel efficiency, environment, Cost-efficiency and Civil-Military Cooperation and Coordination
Start Date	12/12/16
End Date	31/10/2017
Validation Coordinator	ENAV
Validation Platform	R-NEST
Validation Location	EUROCONTROL Bretigny and ENAV Milan ACC
Status	<done>
Dependencies	None

[EXE Trace]

Linked Element Type	Identifier
<SESAR Solution>	PJ.08-01
<Sub-Operating Environment>	ER HC
<Sub-Operating Environment>	ER MC
<Validation Objective>	EX1-OBJ-08.01-V2-VALP-PE1

Linked Element Type	Identifier
<Validation Objective>	EX1-OBJ-08.01-V2-VALP-TF1
<Validation Objective>	EX1-OBJ-08.01-V2-VALP-C01
<Use Case>	UC2
<Use Case>	UC3
<Use Case>	UC5

4.5.2 EXE-08.01-V2-VALP-002

Identifier	EXE-08.01-V2-VALP-002
Title	Collaborative Airspace Configuration based on updated DAC tools with improved predictability and CDM tools for local and network levels.
Description	Operational feasibility of DAC planning process at Regional, Sub-regional and local levels. Assess from operational point of view feasibility and impact on local and Regional ASM processes and compare the benefits of two alternative models of DAC planning process: 1) fully decentralised one, and 2) partially decentralised one.
Expected achievements	Workflow, actors' roles and responsibilities, requirements for future supporting tools at local and Network levels, including HMI have been assessed and refined Operational feasibility of the proposed CDM workflow (from OSED) has been confirmed. Technical feasibility of the DAC tools including DMA type 1/2 definition at sub-regional and regional levels has been assessed.
V Phase	V2
Use Cases	UC01,UC03,UC04,UC05,UC06,UC07,UC08,UC09,UC10
Validation Technique	Gaming, FTS

KPA/TA Addressed	Airspace en-route capacity, fuel efficiency, environment, cost effectiveness and Civil-Military Cooperation and Coordination.
Start Date	01/09/17
End Date	01/02/19
Validation Coordinator	EUROCONTROL
Validation Platform	R-NEST, INNOVE, DAC Actors HMIs mock-up
Validation Location	EUROCONTROL
Status	In progress
Dependencies	EXE-08.01-V2-VALP-001 EXE-08.01-V2-VALP-004 EXE-08.01-V2-VALP-006

[EXE Trace]

Linked Element Type	Identifier
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Linked Element Type	Identifier
<Validation Objective>	EX2-OBJ-08.01-V2-VALP-OF1-003
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<Validation Objective>	EX2-OBJ-08.01-V2-VALP-C01-002
<Validation Objective>	EX2-OBJ-08.01-V2-VALP-C01-003
<Use Case>	UC01
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<Use Case>	UC10

4.5.3 EXE-08.01-V2-VALP-003

Identifier	EXE-08.01-V2-VALP-003
Title	DAC Operational Feasibility and HP assessment
Description	Main objective of the exercise is Operational feasibility of DAC planning and execution process, including HP assessment.
Expected achievements	To provide a local position that is able to identify and propose airspace modifications following the DAC principles. Validate DAC operational feasibility for ATC environment for Spanish airspace to demonstrate performance improvements and to evaluate the impact on Human Performance of the involved actors (Flow/Airspace manager, ATCo, airspace designer) as well as the DAC Dynamicity level against ATC capability. Identify appropriate Sector Design criteria and constrains according to the DAC concept.

	Assess required operational procedures for DAC implementation in the execution phase. Ensure the readiness of DAC for integration in DCB process in a free route environment.
V Phase	V2
Use Cases	UC07: Impact assessment. Describes an assessment of planned DAC configuration on Local KPIs and Network Performance targets. (Limited to the assessment of local KPIs). UC13: ATCO situational awareness in DAC Ops environment. Describes how elements of DAC are displayed on ATCO HMI to ensure ATCo situational awareness. UC14: Air Traffic Control in DAC environment. Describes how an ATCo provides an Air Traffic Control service in DAC operational environment. UC17: INAP2 - Selection of DAC/sector configuration. Describes the decision process for the selection of adequate sector configurations using advanced support functions in short term to execution phase. (Limited to the identification and proposal of sector configuration)
Validation Technique	FTS and RTS
KPA/TA Addressed	HP, Safety
Start Date	06/04/18
End Date	14/06/19
Validation Coordinator	ENAIRE
Validation Platform	iTEC based platform + iACM, RNEST, RAMS
Validation Location	ENAIRE, Madrid
Status	in progress
Dependencies	EXE-VP-08.01.06: requirements for the CWP and initial DAC feasibility issues to be addressed

[EXE Trace]

Linked Element Type	

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<Use Case>	UC14

<Use Case>	UC17

4.5.4 EXE-08.01-V2-VALP-004

Identifier	EXE-08.01-V2-VALP-004
Title	DAC Performance assessment with DMA Type 2/Refined capacity performance assessment of the improved Sector Design and Sector Configuration
Description	The exercise will focus on Dynamic sectorisation + DMA type 2 performance assessment in FRA through a gaming experiment using R-NEST and AIRTOP simulators
Expected achievements	Improvement of fuel efficiency, cost effectiveness and en Route capacity. Confirmation of the Technical feasibility of the integration of DMA type 2 design principles into the DAC tools to generate an optimised airspace configuration Initial conclusions on operational and technical feasibility of DMA-type 2 design principles integrated into DAC for a defined area of Italian Airspace.
V Phase	V2
Use Cases	<UC07> <UC09> <UC10> <UC11> from the SPR-INTEROP/OSED
Validation Technique	FTS
KPA/TA Addressed	En-route capacity, fuel efficiency and environment,cost effectiveness, civil-military cooperation and coordination.
Start Date	18/09/17
End Date	08/06/18
Validation Coordinator	EUROCONTROL
Validation Platform	R-NEST & AIRTOP

Validation Location	EUROCONTROL Bretigny
Status	<in progress>
Dependencies	None

[EXE Trace]**Error! Bookmark not defined.**

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<Use Case>	UC11

4.5.5 EXE-08.01-V2-VALP-005

Identifier	EXE-08.01-V2-VALP-005
Title	DAC integrated in a flow-centric approach, in preparation for integration with INAP WP
Description	Airspace Design and Management using traffic flows and various airspace and traffic metrics; DAC process driven by FMPs and Supervisors working methods.
Expected achievements	Confirmation of the Operational feasibility of the DAC concept for FMP until INAP time horizon. The Supervisor and FMP are able to work with DAC services, which support sectors configuration optimization process. Confirmation that airspace design generated using a flow centric approach, is operationally and technically feasible.
V Phase	V2
Use Cases	• UC 16: INAP1 - Research of the DAC/ACC optimized sector configurations • UC 17: INAP2 - Selection of DAC/sector configuration • UC 18: INAP3 - Exploratory analysis From the SPR-INTEROP/OSED
Validation Technique	FTS, PSM, Judgemental Analysis
KPA/TA Addressed	Capacity, fuel efficiency and cost efficiency (if possible), HP.
Start Date	08/01/18
End Date	30/04/2019
Validation Coordinator	DSNA
Validation Platform	DSNA FTS validation platform
Validation Location	DSNA ACC
Status	In progress
Dependencies	None

[EXE Trace]

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4.5.6 EXE-08.01-V2-VALP-006

Identifier	EXE-08.01-V2-VALP-006
Title	Impact of the DAC on ATCO CWP
Description	The aim of the exercise is to do a preliminary evaluation of DAC concept from the ATCOs perspective. Two day exercise (including needed training sessions) will be organised at ENAV premises and with ENAV controllers. The overall design is to have two treatments (baseline and DAC). Requirements for the CWP and the simulator that will be used in exercise as well as the scope/priorities of the exercise will be defined in collaboration with ENAV and partners involved in other related exercises and projects (DSNA, PANSA, INDRA, ENAIRE, AVINOR, ECTRL).
Expected achievements	Clear buy in from ATCO on the workability of the DAC approach for ATCO CWP (via CWP mock-up developments) Refinement of the OPS requirements for the CWP Validation of the workflow with ATCOs
V Phase	V2

Use Cases	Partly UC 13 and 14 from the SPR-INTEROP/OSED
Validation Technique	Gaming, Judgemental analysis
KPA/TA Addressed	Safety, HP (including workload, SA, human capabilities, team structure and team communication), Cost efficiency
Start Date	01/08/17
End Date	01/09/18
Validation Coordinator	SINTEF (NATMIG)
Validation Platform	SINTEF (NATMIG) CWP Prototype hosted in ENAV (Milano ACC en route Sectors)
Validation Location	ENAV Premises
Status	In progress
Dependencies	Scenarios are generated in EXE#1

EXE Trace]

Linked Element Type	Identifier
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<Sub-Operating Environment>	ER MC
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<Use Case>	UC13
<Use Case>	UC14

Table 9: Validation Exercise layout

4.6 Validation Exercises Planning

[...]

Task Name	Start	Finish
EXE #1	**Mon 12-12-16**	**Thur 14-12-17**
Exercise Plan	Mon 12-12-16	Fri 30-06-17
Execution	Mon 03-07-17	Fri 11-08-17
Post-Exercise	Mon 14-08-17	Fri 13-10-17
Exercise Report	Mon 16-10-17	Fri 14-12-17
EXE #2	**Thu 05-10--17**	**Fri 15-03-19**
Exercise Plan	Thu 05-10-17-17	Fri 29-06-18
Platform development (Availability Note)	Mon 09-10-17	Thu 31-01-19
VP-08-01-02 AN delivered	Fri 01-02-2019	Fri 01-02-19
Execution	Mon 07-02-19	Fri 22-02-19
Exercise Report	Mon 25-02-19	Fri 15-03-19
EXE #3	**Fri 06-04-18**	**Fri 14-06-19**
Exercise Plan	Fri 06-04-18	Fri 25-01-19
Platform development (Availability Note)	Fri 06-04-18	Mon 04-02-19
VP-08-01-03 AN delivered	Mon 04-02-19	Mon 04-02-19
Execution	Mon 04-03-19	Thu 22-03-19
Exercise Report	Mon 25-03-19	Fri 14-06-19
EXE #4	**Tue 02-05-17**	**Wed 30-05-18**
Exercise Plan Part 1	Tue 02-05-17	Fri 05-01-18
Platform development (Availability Note)	Tue 01-08-17	Fri 16-03-18
VP-08-01-04 AN delivered	Fri 30-03-18	Fri 30-03-18
Execution	Mon 05-03-18	Fri 23-03-18
Exercise Report	Mon 26-03-18	Wed 30-05-18
EXE # 5	**Mon 08-01-18**	**Fri 26-04-19**
Exercise Plan	Mon 08-01-18	Fri 26-10-18
Platform development (Availability Note)	Mon 08-01-18	Fri 08-06-18
VP-08-01-05 AN delivered	Fri 15-06-18	Fri 15-06-18
Execution	Mon 17-09-18	Fri 30-11-18
Exercise Report	Mon 03-12-18	Fri 26-04-19
EXE #6	**Mon 04-09-17**	**Fri 19-10-18**
Exercise Plan	Mon 04-09-17	Mon 02-04-18
Platform development (Availability Note)	Mon 04-12-17	Mon 30-04-18
VP-08-01-06 AN delivered	Wed 09-05-18	Wed 09-05-18
Execution	Wed 11-04-18	Fri 11-05-18
Exercise Report	Mon 14-05-18	Fri 19-10-18

4.7 Deviations with respect to the SJU Project Handbook

There is no deviation with respect to the SJU Project Handbook.

The only deviation is regarding what is requested in TVALS [22]: no integrated validation will be performed before reaching V3 maturity level. Nevertheless strong links will be made at the level of OSED developments with PJ09, PJ07 and PJ06. Furthermore, after discussion with PJ19.02, PJ08.01 will keep the traceability only with TVALS, and not with 2018VALS, as some CRT and OBJ IDs have been changed. PJ19.02 will support SJU if needed for the Gate.

5 Validation Exercises

5.1 Validation Exercise 08.01-V2-VALP-001 Plan

This validation exercise plan has been developed under the scope of VP-08-01-01 “DAC Performance".

5.1.1 Validation Exercise description and scope

EXE-08.01-V2-VALP-001 is the first validation exercise planned in the context of PJ08 solution 01 to contribute to reach the PJ08 V2 maturity level.

This validation exercise will simulate different DAC and DMAs configurations based on Italy Free Route environment through a Fast Time Simulation using R-NEST simulator, contributing to:

- a performance assessment of different DAC and DMAs configurations using consistent metrics for the DAC process, to justify the benefits and to contribute to the CBA
- the operational and technical feasibility of the use of automated tool to support the optimisation of sector design, sector configuration and ATC opening scheme as part of the DAC process;
- the operational and technical feasibility of the use of automated tool to support the DMA Type 1 integration into DAC.

EXE-08.01-V2-VALP-001 will be led by ENAV, with EUROCONTROL providing access to R-NEST and support in the preparation of the exercise.

As this exercise opens the loop of exercise on Solution PJ08-01, it starts from the current maturity level, the initial V2, and, provided that the R-NEST supporting tool is mature enough, it should contribute to reach the full V2.

EXE-08.01-V2-VALP-001 addresses mainly OIs AOM-0805, AOM-0809 and partially AOM-0208-B (limited to DMA Type 1) to which are associated the enablers reported in Table 10.

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)	*Required vs Optional	
SESAR Solution 08.01	Management of Dynamic Airspace Configurations	C	Solution 08.01 focus on validation of Dynamic Airspace Configurations (DAC) and Dynamic Mobile Areas (DMAs) of types 1 and 2	**AOM-0208-B**	AAMS-16a	R	

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)	*Required vs Optional	
			in FRA that enable flexible solutions that can be dynamically adapted to traffic demand to respond to different regional/local performance objectives, which may vary in time and place up to concept maturity level 2				
				AOM-0805	AAMS-13	R	
					NIMS-04	R	
				AOM-0809	AAMS-13	R	
					NIMS - 04	R	

**Although not required by EATMA, the project has identified the enablers that will be developed during the project's lifecycle and those which will be used during the validation activities. Should be also noted that at the time of the EXE01, the AOM-0809 was not split in AOM-0809-A &B.*

Table 10: EXE-08.01-V2-VALP-001 OIs and Enablers addressed

The operational concepts and use cases addressed by the exercise EXE-08.01-V2-VALP-001 are defined in SESAR Solution 08.01 OSED Part I:

- Section 3.3.2.1 Dynamic Sectorisation
- Section 3.3.2.2 Dynamic Mobile Areas
- Section 3.3.2.8 Use Cases:
    - UC07: Impact Assessment

5.1.2 Stakeholder's expectations and Benefit mechanisms addressed by the exercise

Stakeholder	Involvement	Why it matters to stakeholder
European Network Manager	No direct involvement in the exercise. However, interested in the outcome	Interested in ensuring effective cooperation between all the stakeholders in moving towards an optimised airspace configuration. Interested in the assessment of the impact of military activities on the Network capacity through improved

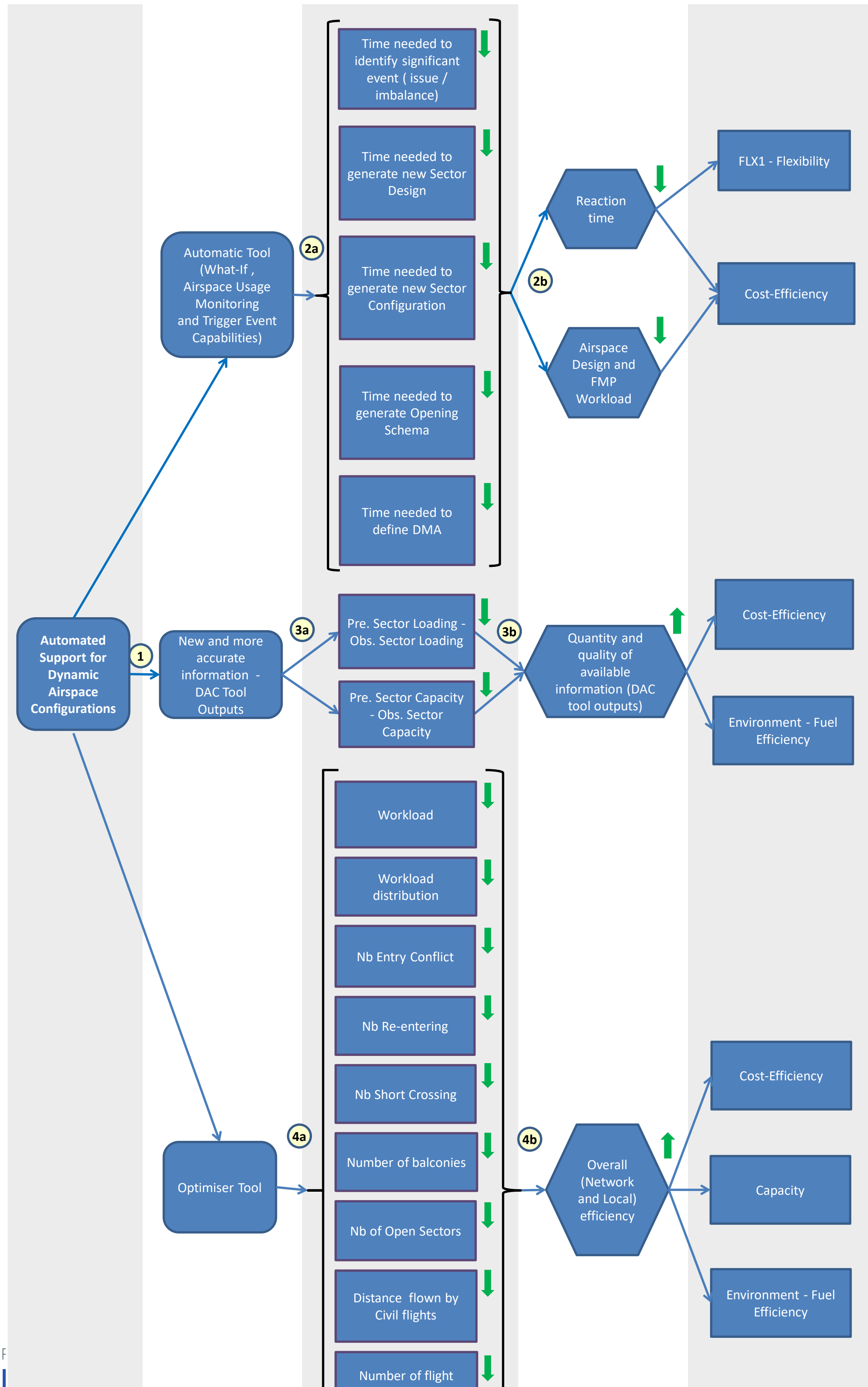
		management of available airspace and coordination between military authorities and airspace users.
ANSP (ENAV)	Leader of the validation exercise (preparation, execution and results analysis) and provider of ATM expertise.	Interested in the optimised use of airspace and wish to increase airspace capacity through Dynamic Airspace Configurations including Dynamic Mobile Areas Type 1 supported by automated tools Wish to assess cost efficiency through optimum use of available human resources. Need to ensure that the roles and responsibilities of the ATCO's with regard to concept are clearly defined. Want to evaluate that the appropriate tools and automated support and procedures used to optimise the airspace configuration are provided.
Airspace Users	No direct involvement in the exercise. However, interested in the outcome.	Interested in achieving fuel efficiency. Interested in the flexible use of airspace on a day-to-day basis.
Military Airspace Users	No direct involvement in the exercise. However, interested in the outcome. Actors in the validation activities. Participation in definition and refinement of DAC concept, provide requirements, participation in exercises	Flexible access to airspace by relying on the responsiveness of airspace management. The need for civil/military coordination through effective and secure exchange of information (collaborative decision making in planning and execution). Performance improvements to civil stakeholders will potentially lead to military flight and operational efficiency improvements. Enhanced interoperability between civil and military communications / navigation / surveillance ground and airborne capabilities.
European Commission	Direct participation through SJU	Have evidence of benefits or potential drawbacks of DAC AND DMA Type 1 design.

Table 11: Stakeholders' expectations

The benefit mechanism identified for the concept improvements [37] targeted by the exercise are:

- Automated Support for Dynamic Airspace Configurations (4a/4b indicators/KPAs, Figure 2)
- DAC level dynamicity (2a/2b – Cost effectiveness and Capacity indicators/KPAs and 3a/3b Civil Military Cooperation & Coordination and Environment Fuel Efficiency indicators/KPAs, Figure 3)

PJ08 ADVANCED AIRSPACE MANAGEMENT



OI Steps:
AOM-0208-B
AOM-0809-A

Figure 2: Benefit Impact Mechanism addressed by EXE-08.01-V2-VALP-001 (Automated Support for Dynamic Airspace Configurations)

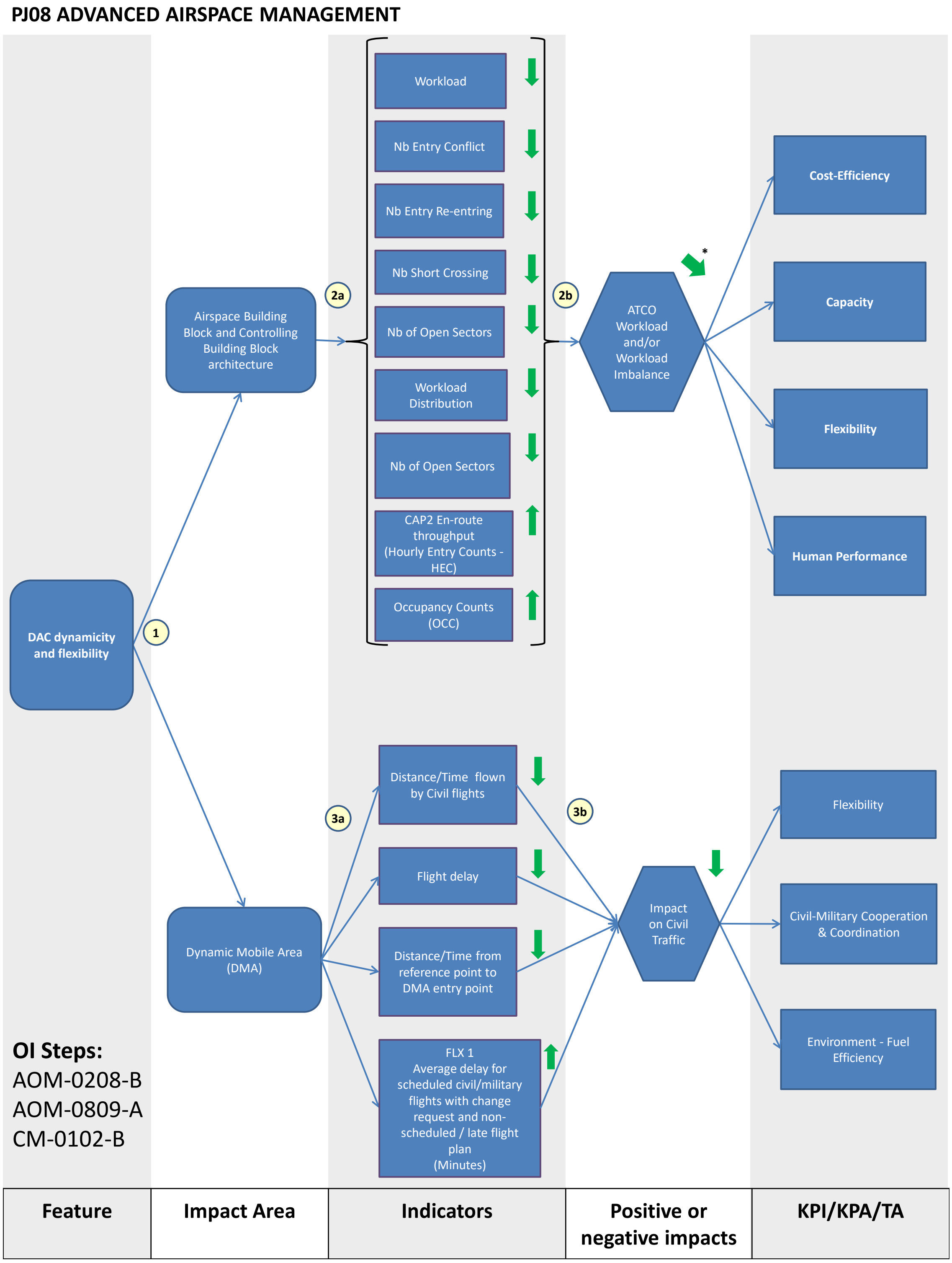


Figure 3: Benefit Impact Mechanism addressed by EXE-08.01-V2-VALP-001 (DAC level dynamicity)

5.1.3 Validation objectives

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments on the coverage of SESAR Solution Validation Objective in EXE-08.01-V2-VALP-001	Exercise Validation Objective	Exercise Success criteria
OBJ-08.01-V2-VALP-PE1	CRT-08.01-V2-VALP-PE1-001	Fully covered with regard to the Success Criterion considered and the KPIs calculated	**EX1-OBJ-08.01-V2-VALP-PE1** same description as OBJ-08.01-V2-VALP-PE1	**EX1-CRT-08.01-V2-VALP-PE1-001** same description as CRT-08.01-V2-VALP-PE1-001
	CRT-08.01-V2-VALP-PE1-003	Fully covered with regard to the Success Criterion considered and the KPIs calculated		**EX1-CRT-08.01-V2-VALP-PE1-003** same description as CRT-08.01-V2-VALP-PE1-003
	CRT-08.01-V2-VALP-PE1-004	Fully covered with regard to the Success Criterion considered and the KPIs calculated		**EX1-CRT-08.01-V2-VALP-PE1-004** same description as CRT-08.01-V2-VALP-PE1-004
	CRT-08.01-V2-VALP-PE1-006	Fully covered with regard to the Success Criterion considered and the KPIs calculated		**EX1-CRT-08.01-V2-VALP-PE1-003** same description as CRT-08.01-V2-VALP-PE1-006
OBJ-08.01-V2-VALP-TF1	CRT-08.01-V2-VALP-TF1-001	Fully covered with regard to the Success Criterion considered and the KPIs calculated	**EX1-OBJ-08.01-V2-VALP-TF1** same description as OBJ-08.01-V2-VALP-TF1	**EX1-CRT-08.01-V2-VALP-TF1-001** same description as CRT-08.01-V2-VALP-TF1-001

	CRT-08.01-V2-VALP-TF1-002	Fully covered with regard to the Success Criterion considered and the KPIs calculated		**EX1-CRT-08.01-V2-VALP-TF1-002** same description as CRT-08.01-V2-VALP-TF1-002
	CRT-08.01-V2-VALP-TF1-003	Fully covered with regard to the Success Criterion considered and the KPIs calculated		**EX1-CRT-08.01-V2-VALP-TF1-003** same description as CRT-08.01-V2-VALP-TF1-003
OBJ-08.01-V2-VALP-C01	CRT-08.01-V2-VALP-CO1-001	Fully covered with regard to the Success Criterion considered	**EX1-OBJ-08.01-V2-VALP-CO1** same description as OBJ-08.01-V2-VALP-CO1	**EX1-CRT-08.01-V2-VALP-CO1-001** same description as CRT-08.01-V2-VALP-CO1-001

Table 12: Validation Objectives addressed in Validation Exercise EXE-08.01-V2-VALP-001

5.1.4 Validation scenarios

The validation scenarios to be studied in the PJ08 EXE-08.01-V2-VALP-001 have been defined to validate Dynamic Airspace Configuration concept and DMA Type 1 on the LIMM West and East sectors, separated Figure 4 and merged into one airspace (Figure 5), of Milan ACC airspace and in a Free Route environment (Figure 6).

The Dynamic Airspace Configuration concept is validated through the run of the SAGA (Sectorisation Automated by Genetic Algorithm) tool to create elementary sectors to fulfil the best practice of sector design operational criteria, and then the COBOS (Configuration Builder for Opening Scheme) tool to combine them into workable sectors and the ICO-DAC analyser to optimise the ACC configuration opening scheme to balance controller usage with overloads, as described in section 5.1.4.2.1.

The DMA Type 1 concept is validated on the best scenario obtained from the dynamic airspace configuration assessment on the merged East and West sectors of Milan ACC through the replacement of two Restricted Areas (LIR4 and LIR68, Figure 7) with a new DMA of about the same volume as described in section 5.1.4.2.2.

5.1.4.1 Reference Scenario(s)

In order to define the reference scenarios for DAC concept assessment, the following topics have been taken into account:

- Link to the validation activities performed in the SESAR1 primary project P07.05.04[38]
- Existence of free-route environment

In continuity with the work done in SESAR I, the sectors considered in this exercise have been the same of project P07.05.04 VP718 Part B, LIMM West and East sectors, separated (Figure 4) and merged together (Figure 5). They are the most suitable portion of Milan ACC airspace to validate the concept, accommodating only en route flights in a FRA environment (Figure 6), and taking into account the following two aspects:

- a high traffic demand/complexity in which DAC and DMA concept is applicable, and
- an optimal vertical split in order to have a perfect adherence to the free route environment.

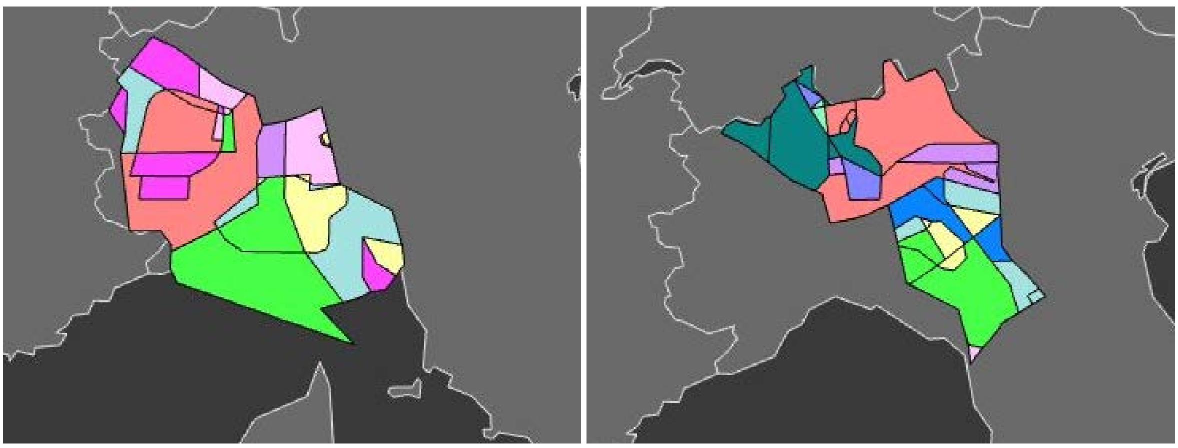


Figure 4: Milan ACC West and East Sectors

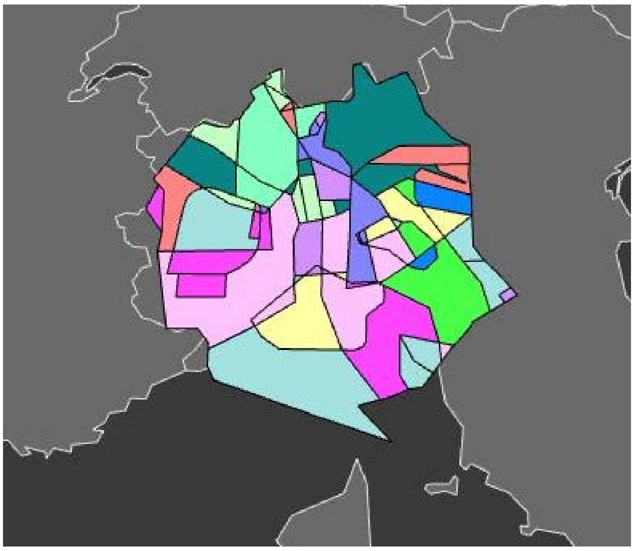


Figure 5: Milan Acc West and East sectors merged into one airspace

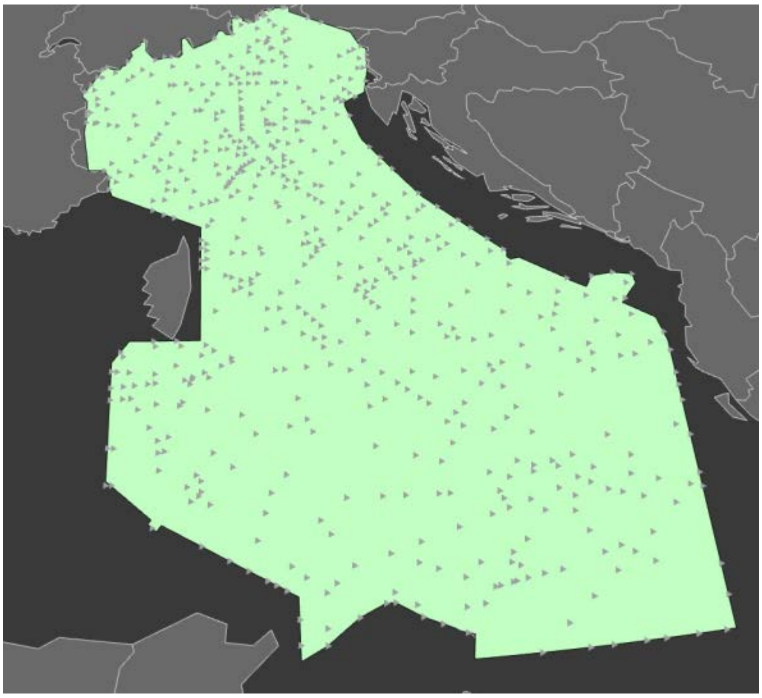


Figure 6: FRAIT (Italian Free Route Airspace)

In order to define the reference scenarios for DMA concept assessment, the following restricted areas have been considered: LIR4 and LIR68 (Figure 7).

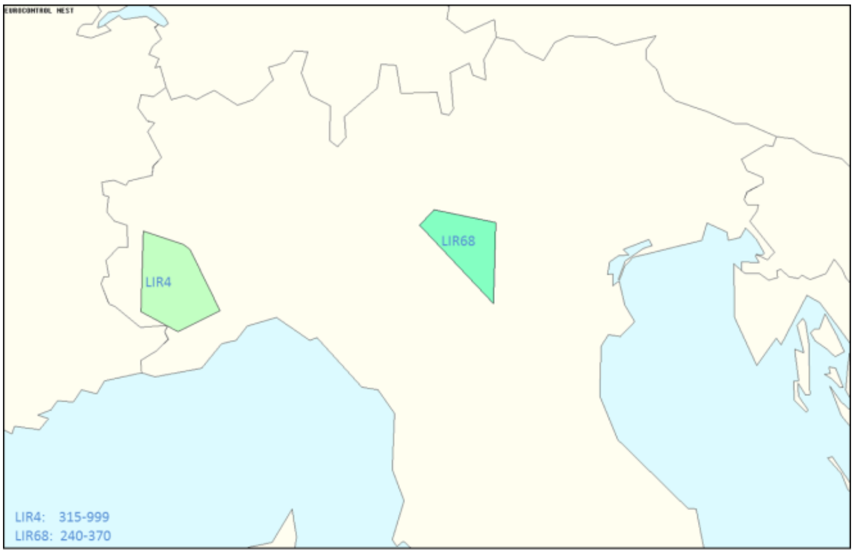


Figure 7: Restricted Areas LIR4 and LIR68

Traffic information

The traffic sample to be used in the exercise has been selected taking into account that DAC concept will support Full Free Route operations. Free Route operations were implemented in December 2016 in the Italian airspace (FRAIT) above FL335, allowing to use real data to feed the exercise. The analysis of real 2017 traffic data available at the time of this validation exercise, showing a progressively increase of Free Route operations, led to a first selection of two days of May, 13th and 19th, and with the availability of the AIRAC Cycle 18-06, to the final selection of the busiest day, the 18th of June.

Taking into account all these elements, Table 13 lists the EXE-08.01-V2-VALP-001 Reference Scenarios.

Identifier	Scenario
SCN-08.01.01-VALP-0001	Reference Scenario Free Route, ACC boundaries and current airspace design/management (Milan ACC West sector) methodology and tools. Traffic: 18 June 2017
SCN-08.01.01-VALP-0002	Reference Scenario Free Route, ACC boundaries and current airspace design/management (Milan ACC East sector) methodology and tools Traffic: 18 June 2017
SCN-08.01.01-VALP-0003	Reference Scenario Free Route, West and East Milan ACC sectors merged Traffic: 18 June 2017
SCN-08.01.01-VALP-0004	Reference Scenario Free Route, West and East Milan ACC sectors merged and restricted Areas LIR4 and LIR68 Traffic: 18 June 2017

Table 13: EXE-08.01-V2-VALP-001 Reference Scenarios

5.1.4.1.1 General description of Milan ACC

For completeness, in this section a general description of the Milan ACC and its currently used configurations are given. Milan ACC is a medium complexity ACC, with complex sectors composing it, with positions allocated according to the kind of airspace and to the workload.

A working position is usually made up of two operational positions which are:

- Executive Controller position (EXE);
- Planner Controller position (PLN).

The current Milan ACC airspace organisation is represented in Figure 8.

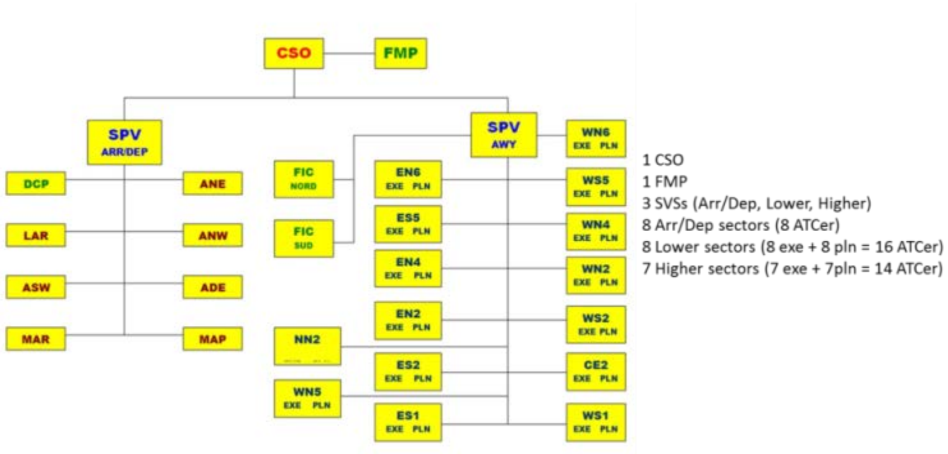


Figure 8: Current Milan ACC airspace organisation

Sectors in Milan ACC are split into three main areas, which are (Figure 9):

- ARR/DEP sectors: ADE – ANE – ANW – ASW – LAR – MAR – MAP.
  Within the following sectors, Approach Service is provided to Milano Malpensa, Milano Linate, Bergamo Orio al Serio and Cameri.
- AWY sectors: ES1 – WS1 – EN2 – NN2 – ES2 – CE2 – WS2 – WN2 – EN4 – WN4 – ES5 – WN5 – WS5 – EN6 – WN6.
  Within the following sectors, Region service is provided.
- FIC sector: FIC Nord – FIC Sud.

  Within the following sectors, Flight Information and Alerting Services are provided to the VFR flights flying into the airspace Class "G".

Figure 9: Milan ACC Layout

Configurations

Milan ACC Sectors can be identified into three main groups, divided to better define the different configurations (Figure 10).

Groups are divided as follow:

- 1st Group: ARR/DEP Sectors, identified by the letter "A" and a number representing the number of open sectors;
- 2nd Group: AWY West side (WS1 – WN2 – WS2 – CE2 - WN4 – WN5 – WS5 – WN6), identified by the letter "W" and a number representing the number of open sectors;
- 3rd Group: AWY East side (ES1 – ES2 – EN2 – EN4 – ES5 – EN6), identified by the letter "E" and a number representing the number of open sectors.

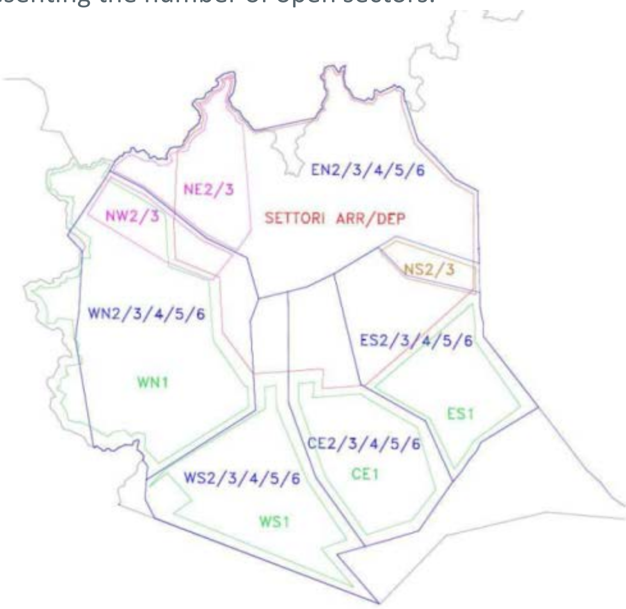


Figure 10: Milan ACC Sectorisation

Therefore, the ongoing configuration will be identified with the three identifiers relating to the three groups of sectors. In our specific case they are E6D for the East sector and W8A for the West sector (Figure 11).

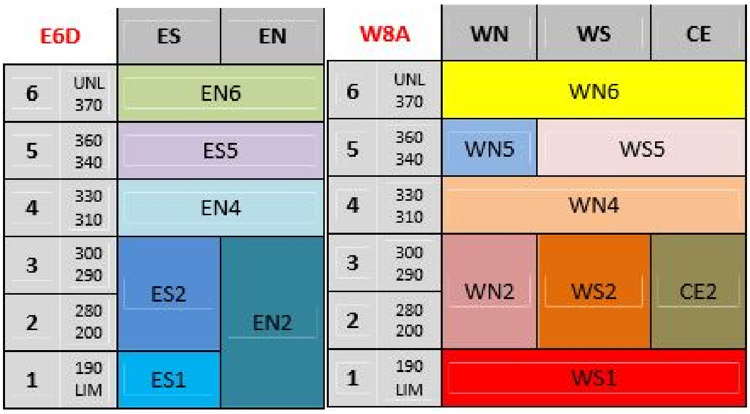


Figure 11: Operational Sectorisation Layout

5.1.4.2 Solution Scenario(s)

Table 14 lists the EXE-08.01-V2-VALP-001 Solution Scenarios.

Identifier	Scenario
SCN-08.01.01-VALP-1001 to be compared to SCN-08.01.01-VALP-0001	Milan ACC West sector using : • SAGA to create different predefined vertical blocks and different predefined horizontal splits to generate elementary sectors • COBOS to have a set of configurations with different DFL • ICO-DAC analyser to generate opening schemes.
SCN-08.01.01-VALP-1002 to be compared to SCN-08.01.01-VALP-0002	Milan ACC East sector using : • SAGA to create different predefined vertical blocks and different predefined horizontal splits to generate elementary sectors • COBOS to have a set of configurations with different DFL • ICO-DAC analyser to generate opening schemes.
SCN-08.01.01-VALP-1003 to be compared to SCN-08.01.01-VALP-0003	Milan ACC West and East sectors merged using : • SAGA to create different predefined vertical blocks and different predefined horizontal splits to generate elementary sectors • COBOS to have a set of configurations with different DFL • ICO-DAC analyser to generate opening schemes.
SCN-08.01.01-VALP-1004 to be compared to SCN-08.01.01-VALP-0004	Milan ACC West and East sectors merged, FRAIT (Italy Free Route) with the activation of: • restricted areas LIR4 and LIR68 and with their replacement respectively with a new DMA of about the same volume • two or more new DMA of different shapes and volume.

Table 14: EXE-08.01-V2-VALP-001 Solution Scenarios

This paragraph lists the runs considered for the Solution Scenarios to be executed in order to validate respectively Dynamic Airspace Configuration concept and DMA Type 1.

<u>Traffic information</u>

The solution scenarios will consider the same traffic day of reference scenario.

5.1.4.2.1 Dynamic Airspace Configurations Scenarios and Runs

Dynamic Airspace Configuration concept will be validated using the SAGA and COBOS algorithms and ICO-DAC analyser.

SAGA is used to decompose a selected volume of airspace into a given number of elementary sectors such as to fulfil the best practice of sector design operational criteria for a given sample of 4-D trajectories, i.e. to:

- Minimise the sectors load imbalance
- Minimise the number of coordinations within the sectorisation and take into account the following operational requirements:
  - Avoiding entering conflicts
  - Avoiding re-entering flights
  - Avoiding short-crossing flights

- Constant later shape of the sector (vertical border)
- Avoiding balconies

COBOS combines a set of airspace components: SBBs/SAMs, or elementary ATC Sectors, that have been defined during the airspace design process, resulting into workable sectors. COBOS computes the configurations with an optimum number of workable sectors to achieve the following objectives and constraints:

- Minimise the total overload of the workable sectors
- Minimise the load imbalance over the workable sectors of the configuration.
- Minimise the inter-workable sectors ATC coordinations.

The following operational constraints and sector design principles are also taken into account:

- Each workable sector is composed of connected airspace elements
- Reduce the number of entering-conflicts to the minimum
- Reduce the number of re-entering to the minimum number
- Reduce the number of short-crossing flights to minimum

Satisfy the number of balconies per sector set by the user.

The ICO-DAC analyser of sector configurations composed of DAC elements (SBBs and SAMs) computes optimised sector opening scheme for a given traffic day to balance controller usage with overloads using a customizable optimisation strategy allowing more dynamicity of the ACC configuration opening scheme.

SCN-08.01.01-VALP-1001/LIMM West sector (Table 15)

- 3 runs on the LIMM West sector using: SAGA to create a different number of predefined vertical blocks with SAGA calculation of a different number of predefined horizontal splits to generate elementary sectors; Selection of SBBs and SAMs and use of ICO-DAC analyser to generate opening schemes
- 3 runs on the LIMM West sector using SAGA to create a different number of predefined vertical blocks and with multiple runs of COBOS to have a set of configurations with different DFL and use of ICO-DAC analyser to generate opening schemes

All the runs referred to the traffic day of 18 June 2017 will be compared to Run 1 of SCN-08.01.01-VALP-0001.

RUN	General Description	DFL suggested
DYNAMIC AIRSPACE CONFIGURATIONS AND SECTOR DESIGN SCN-08.01.01-VALP-1001		
LIMM WEST SECTOR – RUNS		
1	SAGA creation of 4 vertical blocks with SAGA calculation of 6 horizontal split (10 DFL suggested) to generate 24 elementary sector. Selection of SBBs and SAMs. Opening scheme generated by ICO-DAC. Analysis and comparison with current sectorization.	205 285 305 315 325 335 345 355 365 375 555
2	SAGA creation of 6 vertical blocks with SAGA calculation of 4 horizontal split (10 DFL suggested) to generate 24 elementary sectors. Selection of SBBs and SAMs. Opening scheme generated by ICO-DAC. Analysis and comparison with current sectorisation and RUN1.	205 285 305 315 325 335 345 355 365 375 555
3	SAGA creation of 8 vertical blocks with SAGA calculation of 3 horizontal split (10 DFL suggested) to generate 24 ES. Selection of SBBs and SAMs. Opening scheme generated by ICO-DAC. Analysis and comparison with current sectorisation, RUN1, RUN2.	205 285 305 315 325 335 345 355 365 375 555
4	SAGA creation of 4 vertical blocks with multiple run of COBOS to have a set of configurations with 10 DFL suggested. Opening scheme generated by ICO/DAC. Analysis and comparison with current sectorisation, RUN1, RUN2,RUN3.	205 285 305 315 325 335 345 355 365 375 555
5	SAGA creation of 6 vertical blocks with multiple run of COBOS to have a set of configurations with 10 DFL suggested. Opening scheme generated by ICO/DAC. Analysis and comparison with current sectorisation, RUN1, RUN2,RUN3, RUN4.	205 285 305 315 325 335 345 355 365 375 555
6	SAGA creation of 8 vertical blocks with multiple run of COBOS to have a set of configurations with 10 DFL suggested. Opening scheme generated by ICO/DAC. Analysis and comparison with current sectorisation, RUN1,RUN2,RUN3,RUN4,RUN5	205 285 305 315 325 335 345 355 365 375 555

149 **Table 15: SCN-08.01.01-VALP-1001 Dynamic Airspace Configuration LIMM WEST Sectors Runs**

SCN-08.01.01-VALP-1002/LIMM East sector (Table 16)

- 3 runs on the LIMM East sector using: SAGA to create a different number of predefined vertical blocks with SAGA calculation of a different number of predefined horizontal splits to generate elementary sectors; Selection of SBBs and SAMs and use of ICO-DAC analyser to generate opening schemes
- 2 runs on the LIMM East sector using SAGA to create a different number of predefined vertical blocks and with multiple runs of COBOS to have a set of configurations with different DFL and use of ICO-DAC analyser to generate opening schemes

All the runs referred to the traffic day of 18 June 2017 will be compared to Run 3 of SCN-08.01.01-VALP-0002.

RUN	General Description	DFL suggested
	DYNAMIC AIRSPACE CONFIGURATIONS AND SECTOR DESIGN SCN-08.01.01-VALP-1002	
	LIMM EAST SECTOR RUNS	
7	SAGA creation of 3 vertical blocks with SAGA calculation of 6 horizontal split (10 DFL suggested) to generate 18 elementary sector. Selection of SBBs and SAMs. Opening scheme generated by ICO/DAC. Analysis and comparison with current sectorization.	205 285 305 315 325 335 345 355 365 375 555
8	SAGA creation of 4 vertical blocks with SAGA calculation of 4 horizontal split (10 DFL suggested) to generate 16 elementary sectors. Selection of SBBs and SAMs. Opening scheme generated by ICO/DAC. Analysis and comparison with current sectorisation and RUN7.	205 285 305 315 325 335 345 355 365 375 555
9	SAGA creation of 6 vertical blocks with SAGA calculation of 3 horizontal split (10 DFL suggested) to generate 18 ES. Selection of SBBs and SAMs. Opening scheme generated by ICO/DAC. Analysis and comparison with current, RUN7, RUN8.	205 285 305 315 325 335 345 355 365 375 555
10	SAGA creation of 3 vertical blocks with multiple run of COBOS to have a set of configurations with 10 DFL suggested. Opening scheme generated by ICO/DAC. Analysis and comparison with current, RUN7, RUN8, RUN9.	205 285 305 315 325 335 345 355 365 375 555
11	SAGA creation of 4 vertical blocks with multiple run of COBOS to have a set of configurations with 10 DFL suggested. Opening scheme generated by ICO/DAC. Analysis and comparison with current, RUN7, RUN8, RUN9, RUN10.	205 285 305 315 325 335 345 355 365 375 555

Table 16: SCN-08.01.01-VALP-1002 Dynamic Airspace Configuration LIMM EAST Sectors Runs

SCN-08.01.01-VALP-1003/LIMM West and East Sectors merged (Table 17)

- 3 runs on the LIMM West and East sectors merged using: SAGA to create a different number of predefined vertical blocks with SAGA calculation of a different number of predefined horizontal splits to generate elementary sectors; Selection of SBBs and SAMs and use of ICO-DAC analyser to generate opening schemes
- 2 runs on the LIMM West and East sector merged using SAGA to create a different number of predefined vertical blocks and with multiple runs of COBOS to have a set of configurations with different DFL and use of ICO-DAC analyser to generate opening schemes

All the runs referred to the traffic day of 18 June 2017 will be compared to Run 5 of SCN-08.01.01-VALP-0003.

RUN	General Description	DFL suggested
DYNAMIC AIRSPACE CONFIGURATIONS AND SECTOR DESIGN SCN-08.01.01-VALP-1003		
LIMM WEST AND EAST SECTOR MERGED RUNS		
12	SAGA creation of 8 vertical blocks with SAGA calculation of 6 horizontal split (10 DFL suggested) to generate 48 elementary sector. Selection of SBBs and SAMs. Opening scheme generated by ICO/DAC. Analysis and comparison with current sectorization.	205 285 305 315 325 335 345 355 365 375 555
13	SAGA creation of 10 vertical blocks with SAGA calculation of 5 horizontal split (10 DFL suggested) to generate 50 elementary sectors. Selection of SBBs and SAMs. Opening scheme generated by ICO/DAC. Analysis and comparison with current sectorisation and RUN 12.	205 285 305 315 325 335 345 355 365 375 555
14	SAGA creation of 12 vertical blocks with SAGA calculation of 4 horizontal splits (10 DFL suggested) to generate 48 elementary sectors. Selection of SBBs and SAMs. Opening scheme generated by ICO/DAC. Analysis and comparison with current sectorisation, RUN12, RUN13.	205 285 305 315 325 335 345 355 365 375 555
15	SAGA creation of 8 vertical blocks with multiple runs of COBOS to have a set of configurations with 10 DFL suggested. Opening scheme generated by ICO/DAC. Analysis and comparison with current sectorisation, RUN12, RUN13, Run14.	205 285 305 315 325 335 345 355 365 375 555
16	SAGA creation of 10 vertical blocks with multiple run of COBOS to have a set of configurations with 10 DFL suggested. Opening scheme generated by ICO/DAC. Analysis and comparison with current, RUN12, RUN13, RUN14, RUN15.	205 285 305 315 325 335 345 355 365 375 555

Table 17: SCN-08.01.01-VALP-1003 Dynamic Airspace Configuration LIMM WEST and EAST Sectors merged Runs

5.1.4.2.2 Dynamic Mobile Areas Scenarios and Runs

Dynamic Mobile Area concept will be validated using the DMA editor of the R-NEST tool to create volumes, activate them, update the DFLS, created DMA routed trajectories and observe the impact of the DMA routing on the opening scheme.

SCN-08.01.01-VALP-1004/LIMM West and East Sectors merged (Table 18)

- After the selection of the best scenario among the previous first three runs on the LIMM West and East sectors merged, 2 runs considering FRAIT (Italy Free Route) each with the a restricted area (LIR4 and LIR68-AMC) and 2 supplementary runs with the replacement of the restricted area with a new DMA of about the same volume
- After the selection of the best scenario among the previous first three runs on the LIMM West and East sectors merged, 1 run considering FRAIT (Italy Free Route) with the activation of two or more new DMA of different shapes and volume to analyse new business trajectories.

All the runs referred to the traffic day of 18 June 2017 will be compared to Run 7 of SCN-08.01.01-VALP-0004.

The correct re-routing of flights due to DMA activation will be assessed. The automated provision of the best location for a DMA to lower the number of flights impacted has not been considered.

RUN	General Description	Main non-standard options
DYNAMIC MOBILE AREAS RUNS SCN-08.01.01-VALP-1004		
LIMM WEST and LIMM EAST sectors merged (DMA - Best scenario selected RUN 12,13 or 14)		
17	Activation of LIR4 and analysis of new business trajectories in terms of route length, time, fuel and CO2 emission.	Trajectories analysis on large scale considering FRAIT (Italy Free Route)
17B	Replacing of LIR4 (Restricted Area) with a new DMA (about the same volume). Analysis of new business trajectories in terms of route length, time, fuel and CO2 emissions and impact on current MILANO ACC configuration and best RUN among 12, 13, 14.	Trajectories analysis on large scale considering FRAIT (Italy Free Route)
18	Activation of LIR68-AMC and analysis of new business trajectories in terms of route length, time, fuel and CO2 emission.	Trajectories analysis on large scale considering FRAIT (Italy Free Route)
18B	Replacing of LIR68 (Restricted Area) with a new DMA(about the same volume). Analysis of new business trajectories in terms of route length, time, fuel and CO2 emissions and impact on current MILANO ACC configuration and best RUN among 12, 13, 14.	Trajectories analysis on large scale considering FRAIT (Italy Free Route)
19	Activation of two or more new DMA of different shapes and volume. Analysis of new business trajectories.	Trajectories analysis on large scale considering FRAIT (Italy Free Route)

194 **Table 18: SCN-08.01.01-VALP-1004 Dynamic Mobile Areas Type 1 Runs**

195 5.1.5 Exercise Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
PJ08-A#1	Environment constraints	Operating environment	Weather is not taken into account. The exercise will consider operations in nominal conditions	S2020 context	Planning	ENV SAF	PJ08-01	N/A	PJ08-01	Medium
PJ08-Exe1-A#1	Sectorisation	Airspace Layout	Milan sectors considered in the exercise are representative for the real Free Route traffic used	S2020 context	Planning	CAP	PJ08-01	N/A	PJ08-01	Medium
PJ08-A#3	Real Traffic flow in free route airspace	Traffic Layout	Real Free Route traffic used	S2020 context	Planning	CAP SAF ENV	PJ08-01	N/A	PJ08-01	Medium

Table 19: Validation Exercise Assumptions

5.1.6 Limitations and impact on the level of Significance

The potential limitations of ENAV's EXE-08.01-V2-VALP-001 could come from the validation tool, not allowing or partially allowing some configuration assessment, as explained by the following issues, arisen during the preparation of the exercise:

- Slight instability of SAGA and COBOS algorithms, with some system errors occurring when trying to generate an appropriate amount of elementary sectors in order to choose SBBs and SAMs to run COBOS. Even if these system errors can be avoided through the application of alternate procedures to reduce the number of elementary sectors being generated by SAGA, consisting in vertical blocks creation followed by horizontal split of the area, manually merged, these two separate procedures do not always provide the best solution.
- Manual adaptation of constraints, through multiple runs, could be needed when results are not compliant with the selected ones.

With regard to the metrics calculated by R-NEST, the occupancy count seems to represent better the possible overload of ATCOs, whereas the choice of workload value seems not reflect how difficult is the management of separations between climbing and descending flights typical of intermediate sectors compared with that one occurring into lower sectors (where arrival and departure paths are generally separated) and upper sectors (almost entirely dedicated to manage levelled traffic).

Automated provision of the best location for a DMA to lower the number of flights impacted is not allowed by the tool. This will not have a direct impact on the relevance of the exercise results as the shape has been designed to be compliant with real restricted areas.

5.1.7 Validation Exercise Platform / Tool and Validation Technique

5.1.7.1 Validation Exercise Platform / Tool characteristics

V&V Platform Name		
A.1.1	It is a new developed V&V platform?	The V&V platform consists in the continuously updated EUROCONTROL integrated validation tool, R-NEST, combining advanced dynamic ATFCM capabilities with powerful airspace design and capacity planning analysis functionalities. R-NEST offers powerful scenario-based modelling engine to simulate ATM network operations, detect and observe various types of delays, identify and dynamically resolve demand vs capacity imbalances over the network, use concepts such as STAM, create dynamic airspace sectorisation using new algorithms and measure performance improvements of new ATM concepts on a network level. With respect to SESAR1, the integration of COBOS , SAGA and DMA support consists of a large extension of the R-NEST capabilities.
A.1.2	If yes, which are the reasons supporting the development of a new platform?	Not applicable
A.2	It is the first time to be used for a SESAR validation exercise	No It has been already used during SESAR I validation sessions
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	NO As mentioned above, the platform has been already used in previous SESAR validation exercise. EXE-08.01-V2-VALP-001 will use the R-NEST release scheduled end May 2017, including some improvements directly related to DAC and DMA managements.
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	DAC and DMA Management.
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	All the validation needs for this exercise will be covered by R-NEST
D	Which validation methods can be used on the new V&V Platform?	Fast Time simulation

Table 20: Validation Exercise Platform / Tool characteristics

5.1.7.2 Architectural view: mapping Validation Infrastructure and SUTs onto EATMA

V&V Platform Name		EUROCONTROL: R-NEST modelling platform
A.1.1	It is a new developed V&V platform?	NO.
A.1.2	If yes, which are the reasons supporting the development of a new platform?	Not applicable
A.2	It is the first time to be used for a SESAR validation exercise	NO. It has been already used during SESAR I validation sessions ..
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	NO, but the platform has been customised for VP-08.01-01, mainly refinement of the DAC algorithm and DMA1..
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	The strategic phase of DAC as developed in PJ08 OSED: automated support for airspace design using traffic demand, dynamic sector configurations definition, optimal location of DMAs.
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	Building of new airspace design using DAC algorithms, definition of optimized dynamic sector configurations and opening schemes. Computation of optimal location for DMA.
D	Which validation methods can be used on the new V&V Platform?	R-NEST is a fast-time modelling platform.

5.1.7.3 Validation Exercise Technique

EXE-08.01-V2-VALP-001 will use fast time simulation technique in order to collect quantitative data and cover the validation objectives.

The tool involved in this validation exercise is R-NEST version 1.0.0 (Research Network Strategic Tool): R-NEST is EUROCONTROL integrated validation tool combining advanced dynamic ATFCM capabilities with powerful airspace design and capacity planning analysis functionalities. R-NEST offers powerful scenario-based modelling engine to simulate ATM network operations, detect and observe various types of delays, identify and dynamically resolve demand vs capacity imbalances over the network, use concepts such as STAM, create dynamic airspace sectorisation using new algorithms and measure performance improvements of new ATM concepts on a network level.

Site of the exercise

The validation exercise will take place both at the EUROCONTROL Experimental Centre (EEC), located in Brétigny-sur-Orge, France, and at Milan ACC, located in Milan, Italy.

5.1.8 Analysis Specification

5.1.8.1 Data collection methods

This section provides an overview of the data collection methods to obtain the data to be used in the post-execution activities to calculate the metrics and indicators defined for this validation exercise (Table 21).

EXE-08.01-V2-VALP-001 will provide qualitative and quantitative data. Qualitative data are intended as feedbacks coming from user/operator and will be obtained through appropriate questionnaires. Quantitative data are intended as objective measurements and will be obtained as outputs from R-NEST tool, and will be recorded during each run.

Exercise Validation Objective	METRICS/KPI	Data collection method
EX1-OBJ-08.01-V2-VALP-PE1	**CAPACITY/CAP2**: En-route throughput per unit time **Unit**: Relative change of movements (% and number of movement) **Calculation**: number of movements per volume airspace per hour(occupancy counts)	R-NEST Output
	COST EFFICIENCY/CEF2: Flights per ATCO-Hour on duty **Unit**: Nb **Calculation**: Count of Flights handled divided by the number of ATCO-Hours applied by ATCOs on duty.	
	ENV/FEFF1: Average fuel burn per flight **Unit**: Kg fuel per movement **Calculation**: Total amount of fuel burn divided by the number of movements **ENV/FEFF2**: CO2 Emissions **Unit**: Kg CO2 per movement **Calculation**: Amount of fuel burn x3.15 (CO2 emission index) divided by the number of movements **ENV/FEEF3**: Reduction in average flight duration **Unit**: Minutes **Calculation**: Average actual flight duration measured in the Reference Scenario – Average flight duration measured in the Solution Scenario	

	SAF: N° of conflicting SBT/RBTs in reference and solutions scenarios Unit: Nb **Calculation**: N° of conflicting SBT/RBTs in reference and solutions scenarios	
EX1-OBJ-08.01-V2-VALP-TF1	Operator feedback (Validation Expert running the exercise) on DAC and DMAs design Identification of research prototype further requirements needs	Questionnaires
	Operator feedback (Validation Expert running the exercise)	Questionnaires
	Operator feedback (Validation Expert running the exercise)	Questionnaires
EX1-OBJ-08.01-V2-VALP-CO1	The same indicators of EX1-OBJ-08.01-V2-VALP-PE1 calculated for the Free Route Scenario	R-Nest Output
	N° Flight re-routed **Unit:** Nb **Calculation**: N° Flight rerouted due to DMA **Route length extension** **Unit**: Nautical miles **Calculation**: Nautical miles flown of a/c which circumnavigate a DMA **Conflicts** **Unit**: Nb **Calculation**: N° conflicts **Traffic density** **Unit: Nb** **Calculation:** Traffic Density for a given sector is the sum of the time spent by each aircraft in the sector divided by a selected time period	R-NEST Output

Table 21: Metrics and indicators defined for EXE-08.01-V2-VALP-001

5.1.8.2 Analysis method

The quantitative data will be recorded and logged during the exercise for a further statistical analysis. The results obtained for each simulation run will be compared as described in the Scenario description to provide evidence of the operational feasibility of Dynamic Airspace Configuration and Dynamic Mobile Area concepts.

The qualitative data provided by operational experts, will be taken into account during the post processing session and will be used in the assessment and analysis of the final results according to the operational environment of the execution of the exercise.

5.1.9 Exercise Planning and management

5.1.9.1 Activities

The activities concerning EXE-08.01-V2-VALP-001 could be divided into three different topics:

- Preparatory activities
- Execution activities
- Post-execution activities.

5.1.9.1.1 Preparatory activities

The main preparatory activities are described below:

- Definition of the exercise: high level definition of the exercise, including details such as selection of functionalities available in the validation tool, validation scenarios, in terms of airspace and traffic data, validation objectives, indicators to be measured, and data collection measures
- Preparation of the section of Validation Plan related to the exercise
- Preparation of the validation tool
- Training on the new functionalities of the R-NEST tool
- Dry runs of the exercise

5.1.9.1.2 Execution activities Exercise

The main execution activities are described below:

- Run of the exercise using R-NEST
- Data collection of data logs, metrics and questionnaires

5.1.9.1.3 Post Exercise analysis

The main post-execution activities are described below:

- Analysis of the quantitative data collected during the execution phase by comparison of the Solution scenarios with regard to the reference ones and outline of conclusions and recommendation

- Analysis of the qualitative data provided by operational experts during the execution phase

Elaboration of validation Report.

5.1.9.2 Roles & Responsibilities in the exercise

ENAV is the leader of EXE-08.01-V2-VALP-001, and is responsible for the coordination between all partners involved in this exercise.

The main tasks in which ENAV is involved in this validation activity are the following:

- Definition of the validation exercise plan
- Elaboration of the section of Validation Plan related to the exercise
- Exercise preparation and execution
- Post-processing of the outputs
- Analysis of the exercise results
- Elaboration of the section of Validation Report related to the exercise.

The main tasks in which EUROCONTROL is involved in this validation activity are the following:

- Delivery of the R-NEST release with the functionalities to run the exercise
- Training on the new release of the simulation tool
- Hosting and Support to the validation exercise preparation and run
- Collection of the simulation results

5.1.9.3 Time planning

EXE-08.01-V2-VALP-001 main activities will be carried out between Q4 2016 and Q4 2017. The time planning of the validation exercise is shown in Table 22: Detailed time planning.

ACTIVITY	START	END
Preparatory activities	01/12/2016	30/06/2017
Execution activities	03/07/2017	11/08/2017
Post-Execution activities	14/08/2017	13/10/2017
Exercise Validation Report	16/10/2017	31/10/2017

Table 22: Detailed time planning

5.1.9.4 Identified Risks and mitigation actions

Some risks have been identified as susceptible to happen during the different activities that compose EXE-08.01-V2-VALP-001. Table 23 identifies the risks for this exercise as well as their probability of occurrence, their criticality level and the proposed mitigation actions.

Risks	Impact (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High)	Probability (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High)	Mitigation Actions

Risk 1	Limitations of the simulation tool on the level of significance of the exercise	2-Low	List of recommendations for further implementations
Risk 2	Delay due to summer holiday	3- Medium	Coordination between the ENAV and EUROCONTROL teams to ensure the availability for the execution activities to be carried out

312 **Table 23: Risks and mitigation actions**

313

5.2 Validation EXE-08.01-V2-VALP-002 Plan

This validation exercise plan has been developed under the scope of EXE-08.01-V2-VALP-002 “Collaborative Airspace Configuration based on updated DAC tools with improved predictability and CDM tools for local and network levels".

5.2.1 Validation Exercise description and scope

EXE-08.01-V2-VALP-002 is following validation exercises EXE-08.01-V2-VALP2-001 and EXE-08.01-V2-VALP2-004 planned in the context of PJ08 solution 01 to contribute to reach the PJ08 V2 maturity level. This exercise will provide inputs to exercise EXE-08.01-V2-VALP2-003.

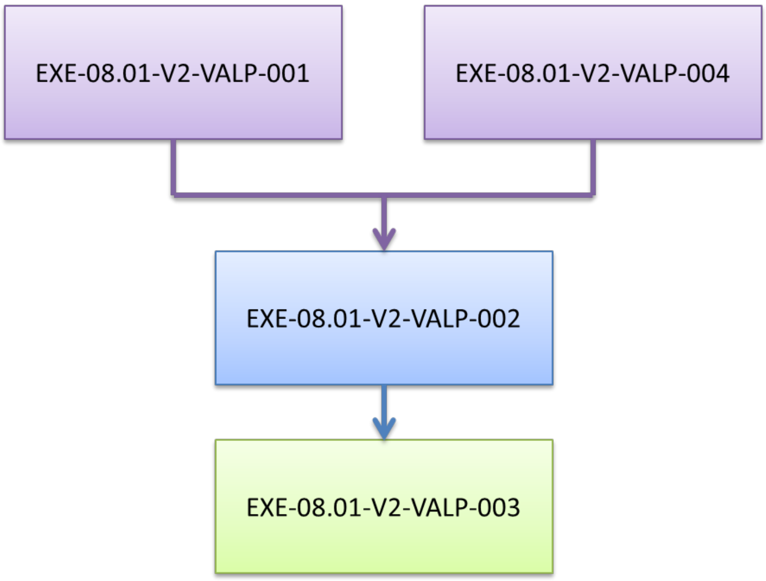


Figure 12: Exercises dependencies

The EXE-08.01-V2-VALP-002 exercise intends to:

- Assess the two DAC Management models defined in the OSED and the operational feasibility of their proposed CDM workflow in the planning phase at regional, and local levels;
- Refine the corresponding DAC processes as well as actors’ roles and responsibilities within the CDM workflow;
- Compare the benefits of the two models of DAC planning process;
- Assess the technical feasibility of the DAC tools functionalities, including the definition and management of DMA type 1 and type 2 at sub-regional and regional levels;
- Identify the operational and technical requirements for the future local DAC tools at local and regional levels.

EXE-08.01-V2-VALP-002 will be led by EUROCONTROL who will also provide INNOVE and R-NEST tools, with DFS providing access to its STANLY_POS tool, PANSA providing access to its CAT tool and AIRBUS providing access to its WOC ASM tool.

All these partners are participating in the preparation of the exercise.

This exercise starts from the current maturity level, the initial V2, and should contribute to reach the full V2 in coordination with other PJ08.01 exercises.

EXE-08.01-V2-VALP-002 addresses AOM-0809-A and CM-0102-B (to which are associated the enablers reported in Table 24).

The operational concepts and use cases addressed by the exercise EXE-08.01-V2-VALP-002 are defined in SESAR Solution 08.01 OSED:

- Section 3.3.2.1 Dynamic Sectorisation
- Section 3.3.2.2 Dynamic Mobile Areas
- Section 3.3.2.4 Medium Term Processes
- Section 3.3.2.8 Dynamic Airspace Configurations Assessment Criteria
- Section 3.3.2.9 Use Cases:
    - UC01: DAC Strategic phase
    - UC03: Initial ASM Request
    - UC04: Performance targets definition
    - UC05: Reference Network Scenario Definition - Initial Ideal sector configuration and DCB imbalance Identification
    - UC06: ATC Volumes vs ASM Volumes assessment
    - UC07: Impact assessment
    - UC08: DAC Coordination
    - UC09: DAC publication/update
    - UC10: DAC Changes assessment
    - UC11: Final DAC publication

The addressed OIs and associated enablers are summarised below in Table 24.

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)	Required v Optional*
SESAR Solution 08.01	Management of Dynamic Airspace Configurations	C	**Solution 08.01 focus on validation of Dynamic Airspace Configurations (DAC) and Dynamic Mobile Areas (DMAs) of types 1 and 2 in FRA that enable flexible solutions that can be dynamically adapted to traffic demand to respond to different regional/local performance objectives, which may vary in time and place up to concept maturity level 2**	**AOM-0208-B**	AAMS-16a	R
					AIMS-15	R
					NIMS-14b	R
					PRO-146	R
				AOM-0805	AAMS-12	R
					AAMS-13	R
					NIMS-04	R
					PRO-010	R
				AOM-0809-A	AAMS-12	R
					PRO-010	R
				CM-0102-B	N/A	

**Although not required by EATMA, the project has identified the enablers that will be developed during the project's lifecycle and those which will be used during the validation activities.*

Table 24: EXE-08.01-V2-VALP-002 OIs and Enablers addressed

5.2.2 Stakeholder's expectations and Benefit mechanisms addressed by the exercise

The different stakeholders' expectations are described in **Table 25** below. Civil Airspace Users are not involved in this exercise but, as they are one of the main beneficiaries of the benefits, they are included in this table.

Stakeholder	Involvement	Why it matters to stakeholder
European Network Manager	Direct involvement in the execution of the validation exercise (preparation, execution and results analysis)	The wish to ensure effective cooperation between all the stakeholders in moving towards an optimised airspace configuration. The need to ensure feasibility of the tools and procedures to support collaborative and coordinated layered planning and execution processes in Network management activities. Would like to see improved efficiency through ATFCM/ASM integration. Interested in assessing the impact of military activities on the Network capacity through improved management of available airspace and coordination between military authorities and airspace users.
ANSP	Provider of ATM expertise. Direct involvement in the execution of the validation exercise and results analysis.	Interested in the optimised use of airspace and wish to increase airspace capacity through Dynamic Airspace Configurations including Dynamic Mobile Areas Type 1 and Type 2 supported by automated tools. Wish to assess cost efficiency through optimum use of available human resources. Ensure that safety is maintained. Want to evaluate that the appropriate tools and automated support and procedures used to optimise the airspace configuration are provided. Ensure operational feasibility, potential benefits of DAC and compliance with performance targets.
Civil Airspace Users	No direct involvement in the exercise. However, interested in the outcome.	Impact of allocated DMAs on flight trajectories. Interested in achieving fuel efficiency. Interested in the flexible use of airspace on a day-to-day basis.
Military Airspace Users	Actors in the validation activities Participation in definition and refinement of DAC	Understanding civil airspace needs to provide flexible access to airspace by relying on the responsiveness of airspace management.

	concept, provide requirements, participation in exercises	The need for civil/military coordination through effective and secure exchange of information (collaborative decision making in planning and execution). Performance improvements to civil stakeholders while keeping mission efficiency. Enhanced interoperability between civil and military communications.
European Commission	Direct involvement through SJU	The EC is particularly interested in the KPA's which involve capacity, efficiency, flexibility and predictability.

Table 25: Stakeholders' expectations

The benefit mechanism identified for the concept improvements targeted by the exercise are presented in the figures (**Figure 13**, **Figure 14** and **Figure 15**) below.

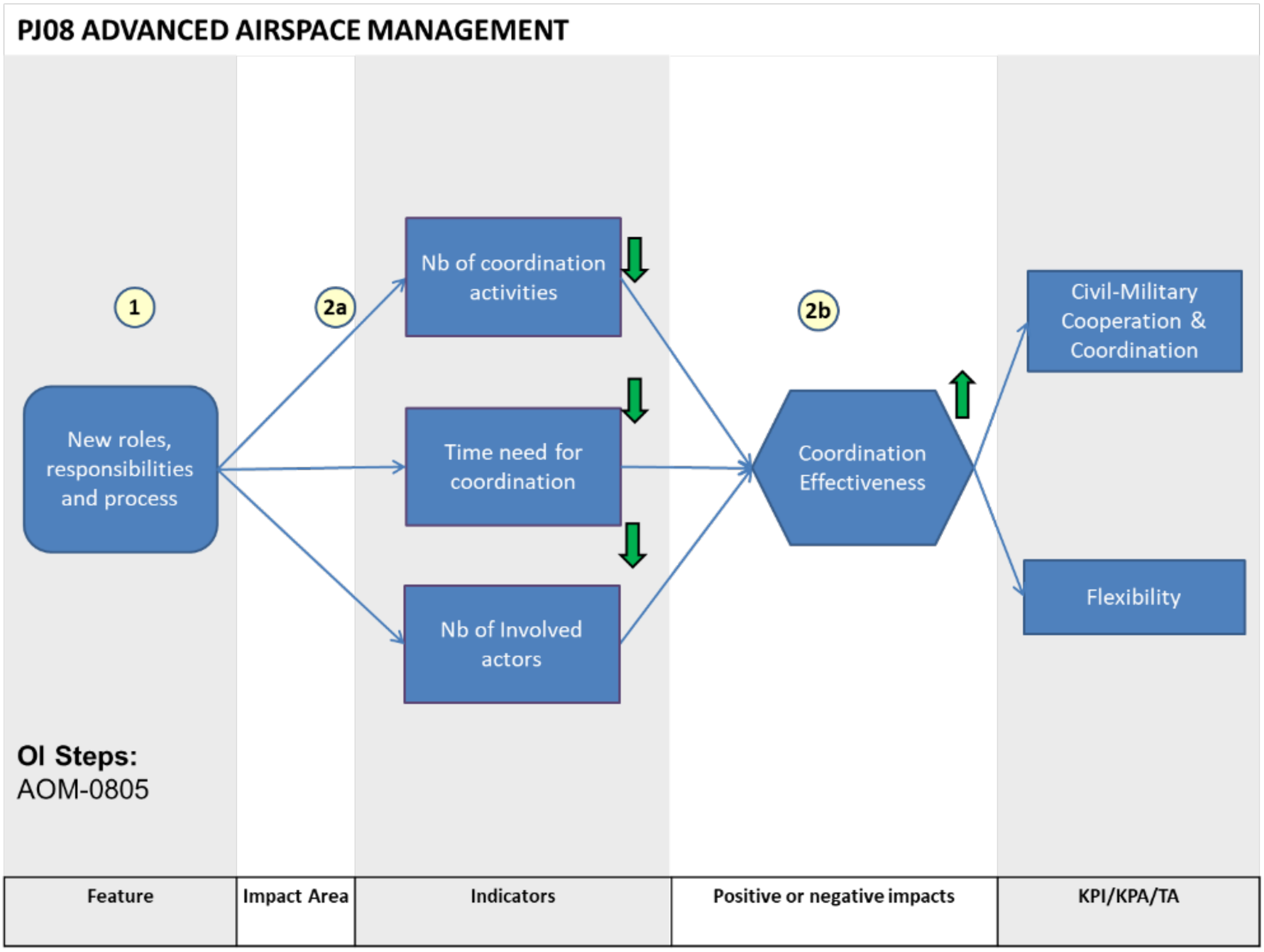


Figure 13: Benefit Mechanism diagram - New roles, responsibilities and processes

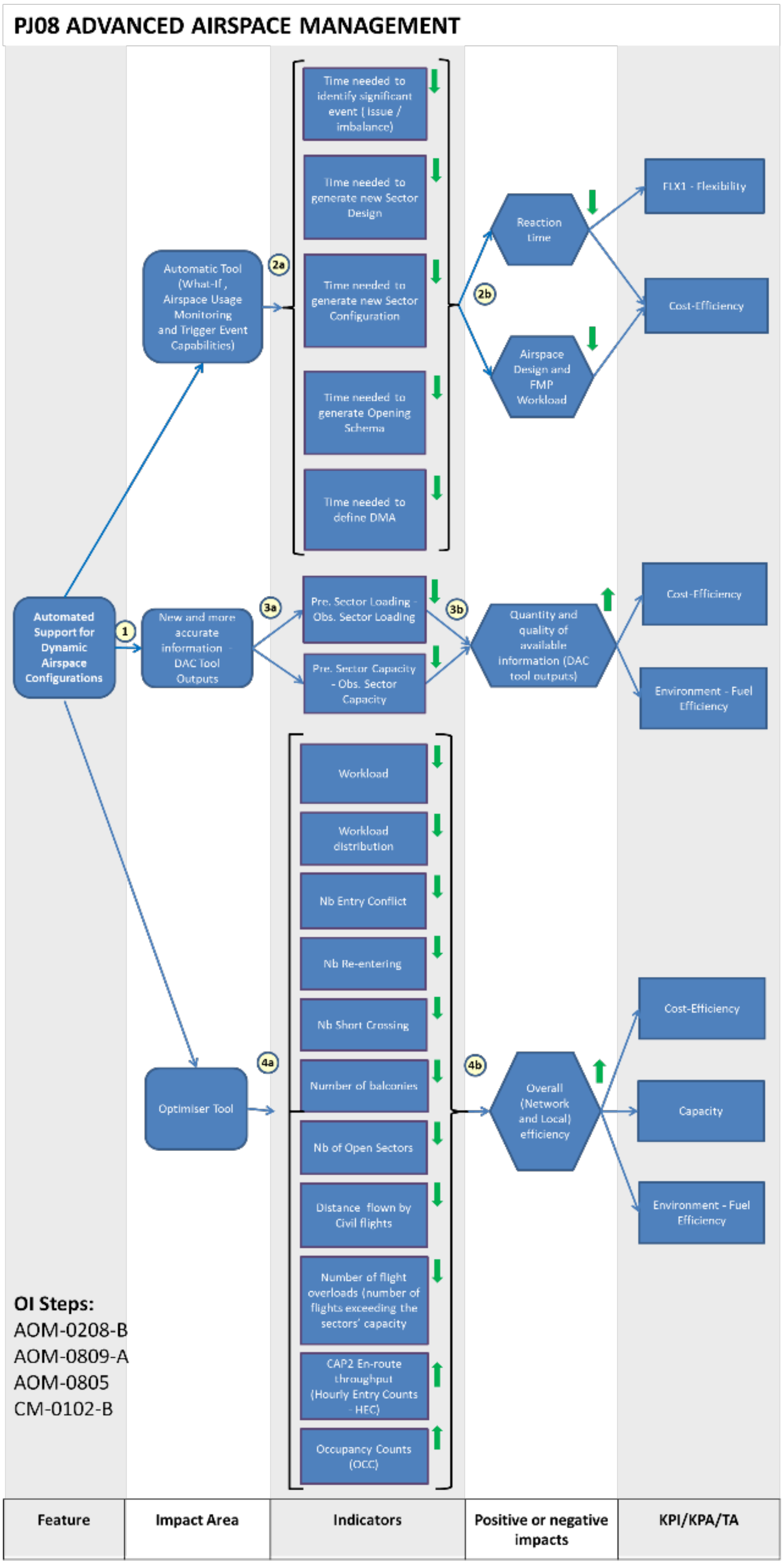


Figure 14: Benefit Mechanism diagram - Automated Support for Dynamic Airspace Configurations

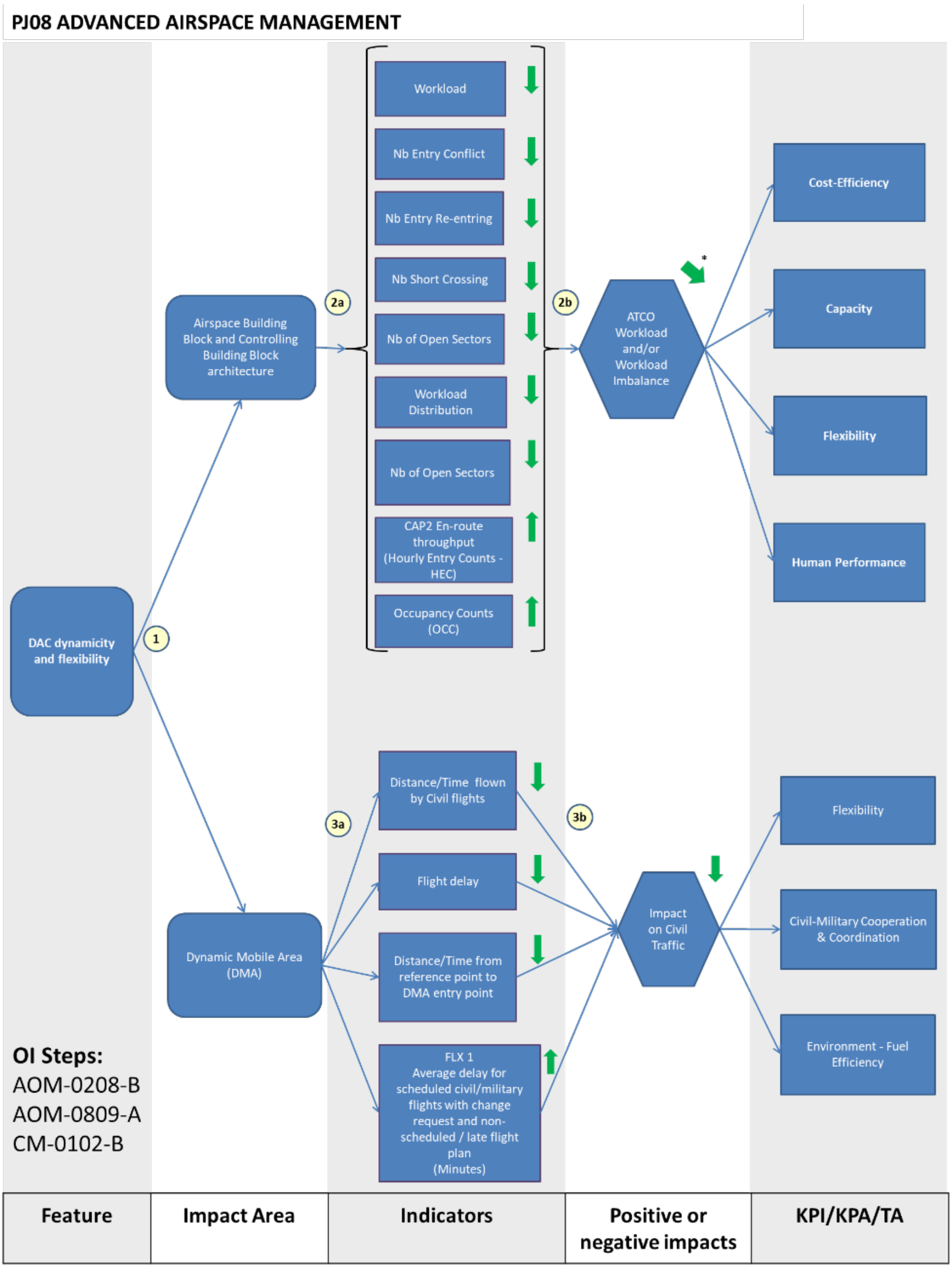


Figure 15: Benefit Mechanism diagram - DAC level dynamicity

379 ### 5.2.3 Validation objectives

380 The relevant validation objectives are collects in **Table 26**.

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments on the coverage of SESAR Solution Validation Objective in Exercise #02	Exercise Validation Objective	Exercise Success criteria
OBJ-08.01-V2-VALP-PE1	CRT-08.01-V2-VALP-PE1-001	Partially covered with regard to the objective considered.[3]	EX2-OBJ-08.01-V2-VALP-PE1-001: To assess whether the DAC and DMA in FRA environment leads to an increase in En-route capacity due to a better airspace configuration which is optimising the use of available airspace.	EX2-CRT-08.01-V2-VALP-PE1-001: DAC and DMA increase En-route capacity in nominal conditions in Free Route Airspace.
	CRT-08.01-V2-VALP-PE1-002		EX2-OBJ-08.01-V2-VALP-PE1-002: To validate that the flight duration variability decreases.	EX2-CRT-08.01-V2-VALP-PE1-002: DAC and DMA decrease flight duration variability in Free Route Airspace compared to static ARES.
	CRT-08.01-V2-VALP-PE1-003		EX2-OBJ-08.01-V2-VALP-PE1-003: To determine if cost efficiency is increased, assuming that a more optimised airspace configuration will lead to improved use of sectorisation opening scheme and ATCO work force.	EX2-CRT-08.01-V2-VALP-PE1-003: A more optimised airspace configuration will increase number of flights per ATCO hour.
	CRT-08.01-V2-VALP-PE1-004		EX2-OBJ-08.01-V2-VALP-PE1-004: To assess whether safety standards remain the same.	EX2-CRT-08.01-V2-VALP-PE1-004: Safety is not degraded (at least number of pre-tactical conflict remains equivalent) and common situation awareness may be increased due automated tools. (no target).

[3] The exercise only covers the planning phase thus all results regarding the different objectives are only covering this phase, not the execution phase.

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments on the coverage of SESAR Solution Validation Objective in Exercise #02	Exercise Validation Objective	Exercise Success criteria
	CRT-08.01-V2-VALP-PE1-005		EX2-OBJ-08.01-V2-VALP-PE1-005: To assess if the DAC and DMA Type 1 & 2 have any positive impact on fuel burn because of better allocation of airspace (and not only due to FRA).	EX2-CRT-08.01-V2-VALP-PE1-005: Optimised flight trajectories and better allocation of ARES by using DMA lead to reduced fuel burn.
	CRT-08.01-V2-VALP-PE1-006		EX2-OBJ-08.01-V2-VALP-PE1-006: To validate the positive impact of the DAC and DMA on civil/military collaboration and coordination.	EX2-CRT-08.01-V2-VALP-PE1-006: Improved civil-military collaboration and coordination enables optimized use of airspace to benefit all airspace users.
OBJ-08.01-V2-VALP-TF1	CRT-08.01-V2-VALP-TF1-001	Partially covered with regard to the objective considered. Limited to the planning phase.	EX2-OBJ-08.01-V2-VALP-TF1-001: To confirm and complete operational and system requirements made for automated support tools for the planning phase.	EX2-CRT-08.01-V2-VALP-TF1-001: The definition of requirements for automated support tools to support the actors activities.
	CRT-08.01-V2-VALP-TF1-002		EX2-OBJ-08.01-V2-VALP-TF1-002: To carry out an initial assessment on the feasibility and –usability of automated tools functionalities provided to support the decision making process and to compare the different airspace configurations in planning phase.	EX2-CRT-08.01-V2-VALP-TF1-002: The automated tools provided to assess, and compare the different airspace configurations are fit for use and support the actors in their decision- making tasks.
OBJ-08.01-V2-VALP-OF1	CRT-08.01-V2-VALP-OF1-001	Partially covered with regard to the objective considered. Limited to the planning phase.	EX2-OBJ-08.01-V2-VALP-OF1-001: To validate the human capability to successfully accomplish tasks and meet job requirements in the planning phase.	EX2-CRT-08.01-V2-VALP-OF1-001: The actor’s workload is reasonable, the situational awareness is increased, a good level of flexibility is provided and the job objectives are met.

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments on the coverage of SESAR Solution Validation Objective in Exercise #02	Exercise Validation Objective	Exercise Success criteria
	CRT-08.01-V2-VALP-OF1-002		EX2-OBJ-08.01-V2-VALP-OF1-002: To assess and further develop the defined operational procedures and identified roles of the actors involved in the planning phase.	EX2-CRT-08.01-V2-VALP-OF1-002: The operational procedures are defined, roles have been identified.
	CRT-08.01-V2-VALP-OF1-003		EX2-OBJ-08.01-V2-VALP-OF1-003: To validate the acceptability of the concept proposed by the different actors involved.	EX2-CRT-08.01-V2-VALP-OF1-003: The actors involved recognize the concept benefits and feasibility.
OBJ-08.01-V2-VALP-C01	CRT-08.01-V2-VALP-CO1-001	Partially covered with regard to the objective considered. Limited to the planning phase.	EX2-OBJ-08.01-V2-VALP-C01-001: To assess the operational feasibility of the concept and performance benefits when the concept is integrated in the Free-Route environment.	EX2-CRT-08.01-V2-VALP-CO1-001: The exercise provides evidence that the concept is feasible and provides benefits to the actors when used in free route environment.
	CRT-08.01-V2-VALP-CO1-002		EX2-OBJ-08.01-V2-VALP-C01-002: To assess the identified relationships between dynamic airspace configuration concept and DCB concept.	EX2-CRT-08.01-V2-VALP-CO1-002: The relationships between DAC and DCB concepts are identified and the two concepts are consistent and complementary
	CRT-08.01-V2-VALP-CO1-003		EX2-OBJ-08.01-V2-VALP-C01-003: To assess the identified relationships between dynamic airspace configuration concept and DCB concept.	EX2-CRT-08.01-V2-VALP-CO1-003: The relationships between DAC and DCB concepts are identified and the two concepts are consistent and complementary.

381 **Table 26: Validation Objectives addressed in Validation Exercise #02**

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5.2.4 Validation scenarios

This section is presenting the scenarios for EXE-08.01-V2-VALP-002.

As described in 5.2.1 validation exercise EXE-08.01-V2-VALP-002 addresses the “Collaborative Dynamic Airspace Configuration based on updated DAC tools with improved predictability and CDM tools for local and Network levels”.

Following the exercise scope and in order to achieve the validation objectives listed in section 5.2.3, two reference and four solution scenarios were created, listed in **Table 27**.

The Reference scenarios (RS) have been built on two dimensions:

- The UAC/ACC(s) within the respective Area of Responsibility (AoR) perform their tasks in an environment with regular military activities.
- The ACCs within the respective AoR perform their tasks in an environment with extensive military activities.

Scenario 1:

The civil part of Reference Scenario 1 (RS01) represents the German (DFS) and Polish (PANSA) ANSPs, providing ATS within the relevant UAC/ACC(s) in a busy summer week-end day of civil traffic and managing the concerned by the military activities sectors according to the approved roster for ATCOs.

The Civil AUs are planning their operations, considering national and international flight planning requirements in particular the relevant implementation of FRA, submitting FPLs to the Network Manager Operations Centre (NMOC).

The Military AU Reference scenario 1 scope is conducting of regular daily training activities by German and Polish air forces, characterised by relatively moderate intensity of sorties, standard training objectives, usage of regular size of required volumes of airspace and with coordination at national level.

Scenario 2:

The civil part of Reference Scenario 2 (RS02) represents the German (DFS) and Polish (PANSA) ANSPs, providing ATS within the relevant UAC/ACC(s) in a busy summer week-end day to civil traffic, which is highly affected by the ongoing military activities. The UAC/ACC(s) are performing their tasks in close coordination with national military AUs (CMCC) and neighbouring UAC/ACC (sectors) across the state (UIR/FIR) border.

The Civil AUs are planning their operations, considering the national and international flight planning requirements, in particular the relevant implementation of FRA, submitting FPLs to the Network Manager Operations Centre (NMOC). Some ATFCM measures can be expected to avoid significant overloads (in any) but their corresponding delay will not be measured.

Reference scenario 2 for the Military AUs represents an execution of military exercises, conducted by German and Polish air forces with high intensity of sorties, complex mission objectives, usage of large size volumes of airspace and coordination at local and network levels. The military activities are close to the German – Polish border and coincide in time, although they are not tactically linked. Nevertheless, information between the German and Polish AMC will be exchanged.

The Network Manager (NM) performs in both the Reference scenarios (RSs) the same tasks as today.

Both the reference scenarios aim at execution of the simulation activities:

- Within the current ASM organisation environment;
- With UAC/ACC(s) performing sector configurations according to their current regular planning.
- By in the (A)FUA concept described processes of requesting, coordinating and booking of airspace, and as defined in EC and local regulatory documents, procedures and guidance materials;
- With the usage of fixed type ARES (including VPA);
- With the NM involvement with the tasks performed today for the European network (ATFCM);
- With the Civil AUs submitting their FPLs to the NMOC according to the different FRA implementations.

A week-end day has been chosen to avoid Civil Airspace Users to anticipate the activation of Military areas in their filed flight plan.

The Solution scenarios are developed on the basis of SESAR operational concept by exploiting the DAC and DMA concepts elements, as described in the PJ08 OSED [37]:

- Free route operations in trajectory based operations (TBO) environment;
- UAC/ACC(s) perform sector configuration dynamically supported by DAC automated tools, according to the environment changes;
- The notion of ATC volume which allows local DAC actors to identify areas of (already) complex situations;
- Military AUs requests, coordination and location of required airspace reservations supported by WOC and DAC tools;
- Using CDM processes facilitated by DAC tools according to the two DAC management models defined in the OSED [37];
- The role of NM – following the operational processes according to the two DAC management models defined in the OSED [37];
- Usage of DMA type 1 and 2;
- The Civil AUs share their BTs developed for the user preferred routing planning (Civil Airspace Users are not involved in this exercise: the filed flight plans will be used as an input).

Airspace design activities will be performed during the exercise preparation activities: a new airspace design for Polish ACC will be made using R-NEST SAGA DAC algorithm taking into account the traffic demand and the number of sectors defined by the local FMP experts.

There are two types of Solution scenarios per each Reference scenario – one for model A (partially distributed) and one for model B (fully distributed) of DAC management organisation as described in the OSED [37].

The military dimension of Solution scenarios is developed for the same number and types of missions and similar sizes of airspace volumes as in the two reference scenarios, therefore military part of Solution scenarios is identical for model A and model B. The Solution scenarios are replicating the processes logged in the Use Cases listed in section 5.2.1.

Briefly, the two models are presented below.

Model A represents a partially distributed DAC Management process. Operational meaning of this model is that the DAC management functions on a "top down" approach, which gives the initial proposal for solution to the Network Manager function. NM is kicking off, coordinating and monitoring the DAC planning process with local actors assisting NM with their local expertise, data and knowledge. However, the closer to the execution phase the more responsibilities are shifted from NM towards local DAC management level.

Model B represents a fully distributed DAC Management process. This model assumes a "bottom-up" DAC management approach characterised by a leading role of local actors (at national or sub-regional level depending on local organisation) in the DAC management process where they all provide initial proposals consolidated by the Network Manager in coordination with all local actors.

Identifier	Scenario
SCN-08.01.02-VALP-0001	Reference scenario 1 Regular military activities (RS01)
SCN-08.01.02-VALP-0002	Reference scenario 2 Extensive military activities (RS02)
SCN-08.01.02-VALP-1001	Solution scenario 1.1 DAC model A in regular military activities (S11)
SCN-08.01.02-VALP-1002	Solution scenario 1.2 DAC model A in extensive military activities (S12)
SCN-08.01.02-VALP-2001	Solution scenario 2.1 DAC model B in regular military activities (S21)
SCN-08.01.02-VALP-2002	Solution scenario 2.2 DAC model B in extensive military activities (S22)

Table 27: List of Validation Scenarios in Exercise #02

5.2.4.1 Scenarios environment

5.2.4.1.1 Airspace and Airports

Exercise scenarios are developed for FRA environment within POLFRA (POLFRA is an internal PANSA's project, aimed to implement FRA in FIR Warszawa H24 from FL095) and FRA_GER airspace.

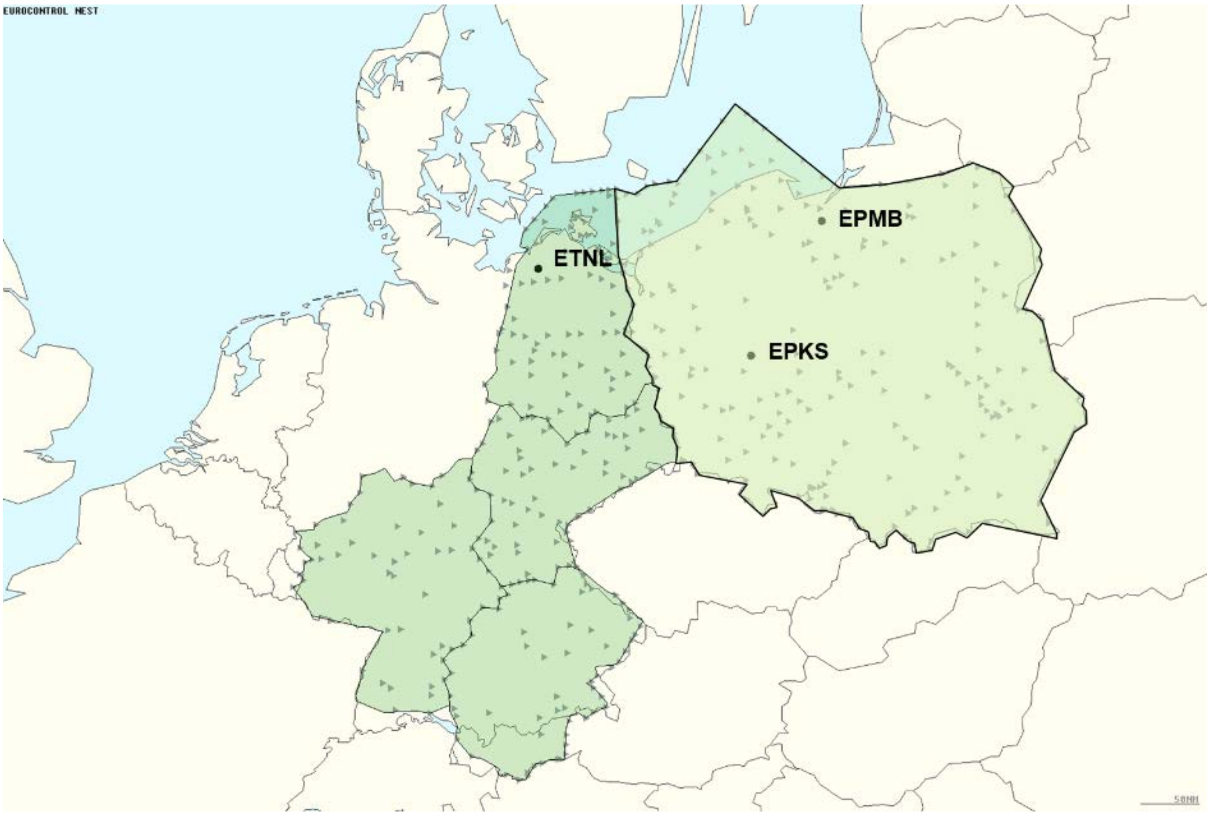


Figure 16: EXE-08.01-V2-VALP-002 Airspace and Airports

The following (military) airports are used for the scenarios development.

- **Germany - ETNL**
- **Poland - EPMB, EPKS**

5.2.4.1.2 Traffic sample

The traffic sample is selected from one of the busy weekends during the summer period. The rationale is to simulate as much as possible the challenges of FRA environment civil operations with a strong demand and to add airspace reservations that usually take place during week days. These airspace reservations will not be anticipated by the civil traffic, allowing to really assess the impact of airspace reservations on traffic based on preferred routes in both reference and solution scenario. This gives the DAC tools more options for computing optimized DMA positions compared to a working day traffic which is significantly restrictive.

Traffic is selected from a day during a weekend in July 2018 and will be increased (by cloning existing flights) using STATFOR forecast for 2023 base scenario assumptions and adapted to FRA environment.

5.2.4.1.3 Involved participants and corresponding exercise roles

The tables below show the scenarios actors and their role(s) in the exercise

Germany:

Scenario actor	EXE-08.01.02 role

AMC Germany (DFS AMC expert)	Local DAC ASM (using STANLY_POS tool)
Planning and Coordinating Agency for military airspace requests (COSA) (DFS AMC expert)	WOC (using WOC ASM tool)
FMP EDUU (Rhine) (NM EEC)	Local DAC ATFCM (using INNOVE tool)

Table 28: Germany scenario roles in Exercise #02

Poland:

Scenario actor	EXE-08.01.02 role
AMC Poland (PANSA AMC expert)	Local DAC ASM (CAT)
Military ATS Office (MATSO)	WOC (WOC ASM)
Military AUs	WOC (WOC ASM)
Warsaw FMP (PANSA FMP expert)	Local DAC ATFCM (CAT)

Table 29: Poland scenario roles in Exercise #02

NM

Scenario actor	EXE-08.01.02 role
NM/ATFCM	NM (INNOVE)
NM/ASM	NM (INNOVE)
NM/MILO	NM (INNOVE)

5.2.4.2 Reference Scenarios (RS)

Reference scenarios simulate an execution of the aerial activities of current day operations. The simulation aims at collecting data for comparison with the one from the Solution scenarios execution.

5.2.4.2.1 SCN-08.01.02-VALP-0001 Reference Scenario 1 Regular military activities (RS01)

The operational RS01 story is as follows:

5.2.4.2.1.1 Civil part of RS01

The current German airspace sectorisation and configurations will be used (as already in FRA environment).

Data from POLFRA implementation project, which is planned to be implemented on the AIRAC 28.02.2019, will be used for the reference scenario (including FRA definition, sectorisation and configurations).

The civil traffic will use the flight plan demand augmented with STATFOR forecasts for 2023. It will be adapted in the Polish area to reproduce the FRA environment.

R-NEST ICO opening scheme optimizer will be used to define the best sector configurations to be used for Polish and German airspaces.

5.2.4.2.1.2 Military part of RS01

RS01 represents a snapshot from “regular” type of daily military training activities, conducted by German and Polish air forces. Such activities are characterised by relatively moderate intensity of sorties, standard training objectives, usage of regular size of required volumes of airspace and coordination at national level.

For execution of the military planning the relevant AMCs develop the AUPs for D-Ops.

Military planning and military-military coordination are not reflected in this plan as they are not relevant to DAC scenarios set-up.

The following symbols are used in depiction of the scenarios:

Symbol	Description
	BFM Basic Fighter Manoeuvring #1 – means that it is the first task in the planned mission
	AAR Air to Air Refuelling #2 – the second task in a planned mission
	ACT Air Combat Training #3 – the third task in a planned mission

Table 30: Symbols used in scenarios depiction

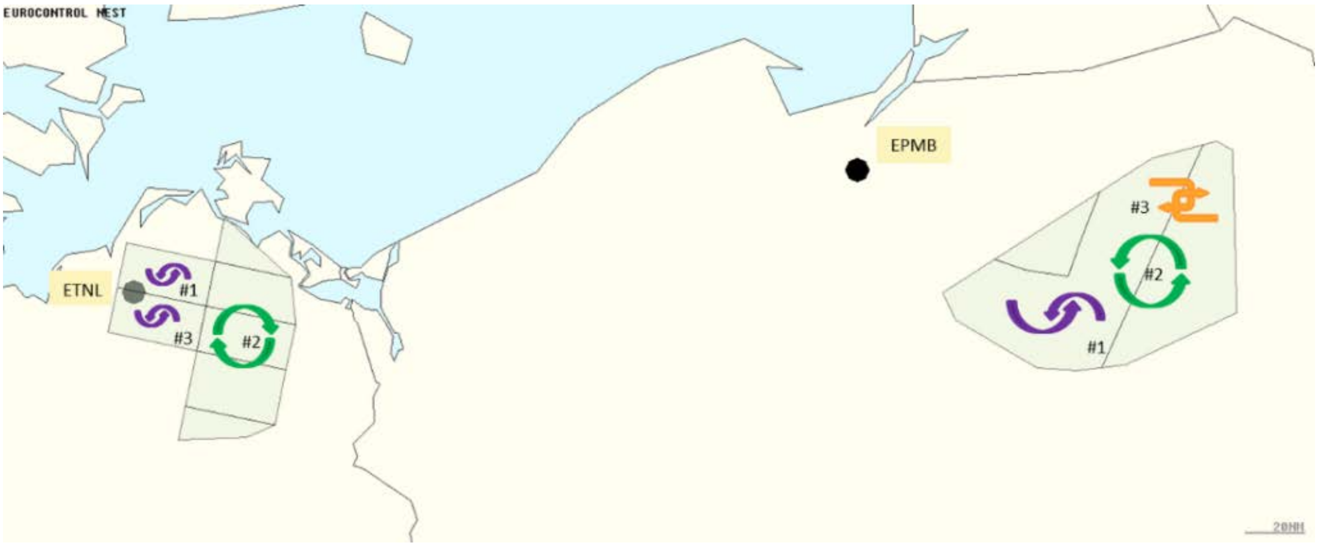


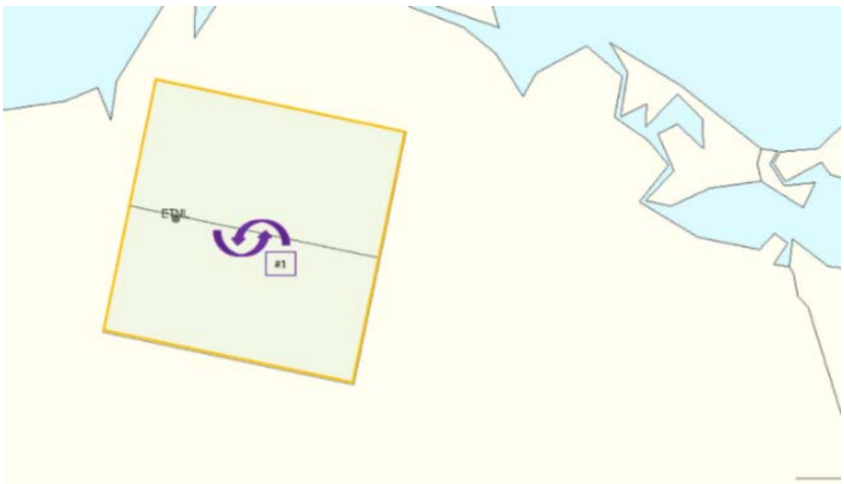
Figure 17: Geographical scope of military missions in RS01

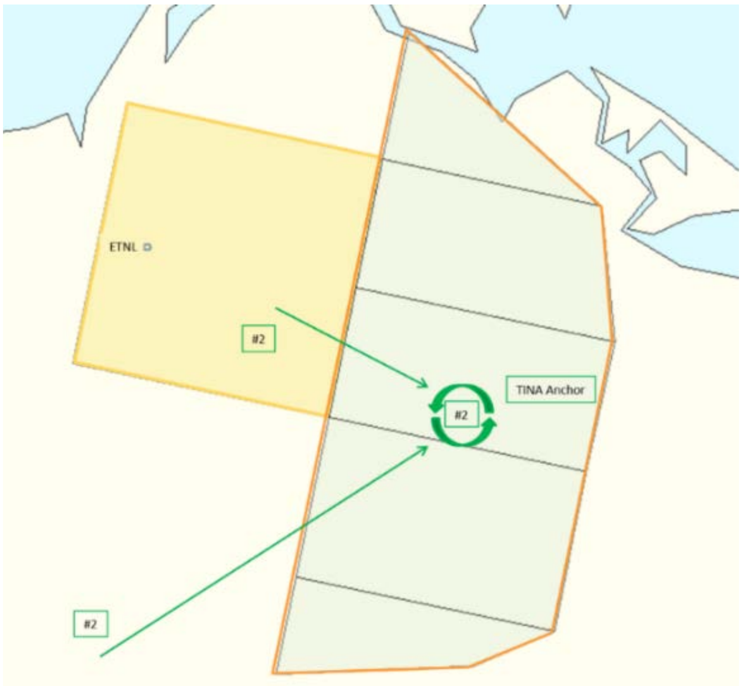
AMC Germany

Develops the AUPs for execution of military aerial activities, based on the planning of GAF:

1) The GAF plans to execute missions for training of a basic fighter manoeuvring conducted by two Eurofighters interrupted by air-to-air refuelling. The constraining factor in this mission is the time availability of the tanker and mission synchronisation. The mission planning is based on the confirmed AAR slot.
2) GAF tactical scenario:

Two fighters depart from AFB Laage to the training area MVPA BASIC 1BC, which is right above the AFB and start BFM from 08:00 on. The tanker arrives in the TINA AAR anchor at 08:45. The fighters leave BASIC 1BC for the AAR anchor and refuelling starts at 09:00 and lasts for 30 minutes. After refuelling, the fighters return to their training area and perform the BFM activity until 10:30, and the tanker returns to base.





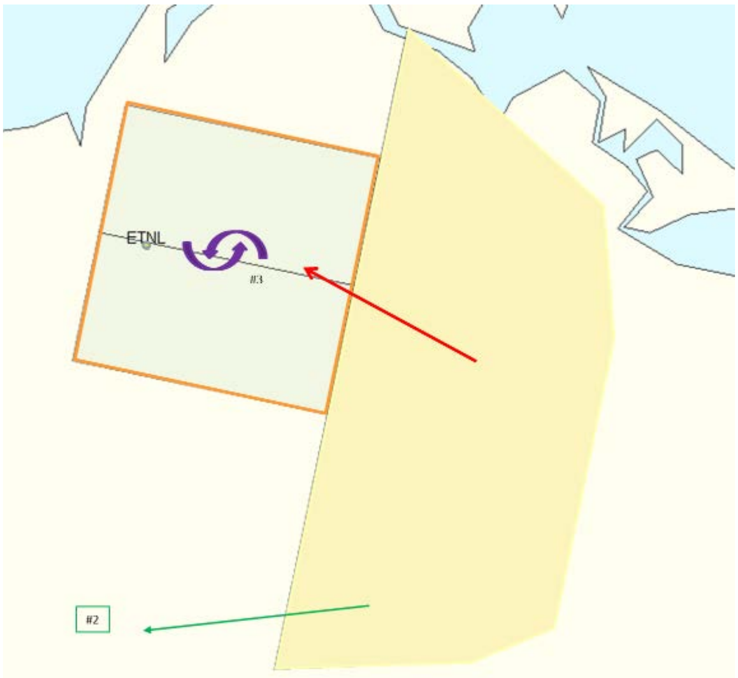


Figure 18: Mission planning Germany RS01

3) To execute the exercise GAF request the following airspace reservations:

<u>ARES 1:</u>

Airspace	VALIDITY		FL MIN	FL MAX	ACTIVITY	UNIT	Number a/c
ED-R401 BASIC 1BC	08:00	09:00	200	380	BFM	TaktLwG 73 Laage	2/EUFI

ED-R401 BASIC 1BC	09:30	10:30	200	380	BFM	TaktLwG 73 Laage	2/EUFI

ARES 2:

Airspace	VALIDITY		FL MIN	FL MAX	ACTIVITY	UNIT	Number a/c
TINA ANCHOR	08:30	10:00	200	240	AAR	EDDK	1/A310 2/EUFI

Table 31: Airspace reservations RS01 AMC Germany

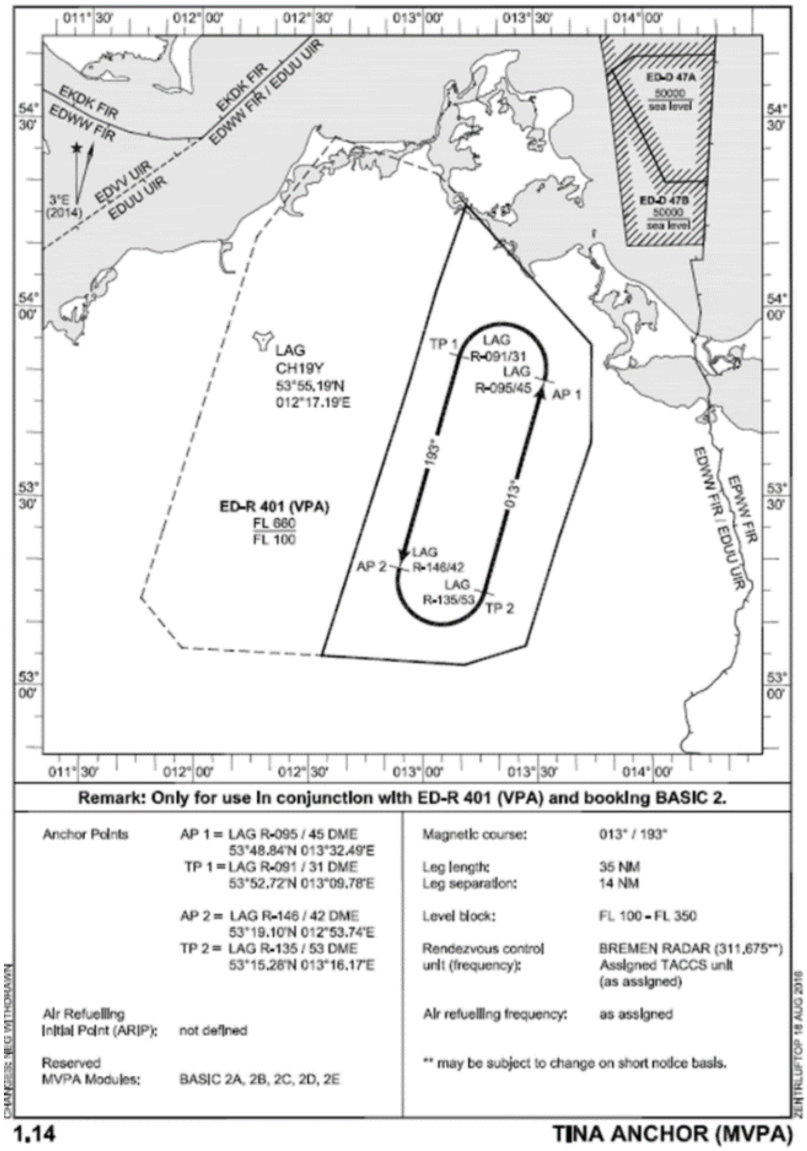


Figure 19: TINA Anchor data - AMC Germany RS01

No specific FUA restrictions are defined in the frame of this exercise. During times of activation of the military airspaces it is assumed that no traffic will be allowed to cross.

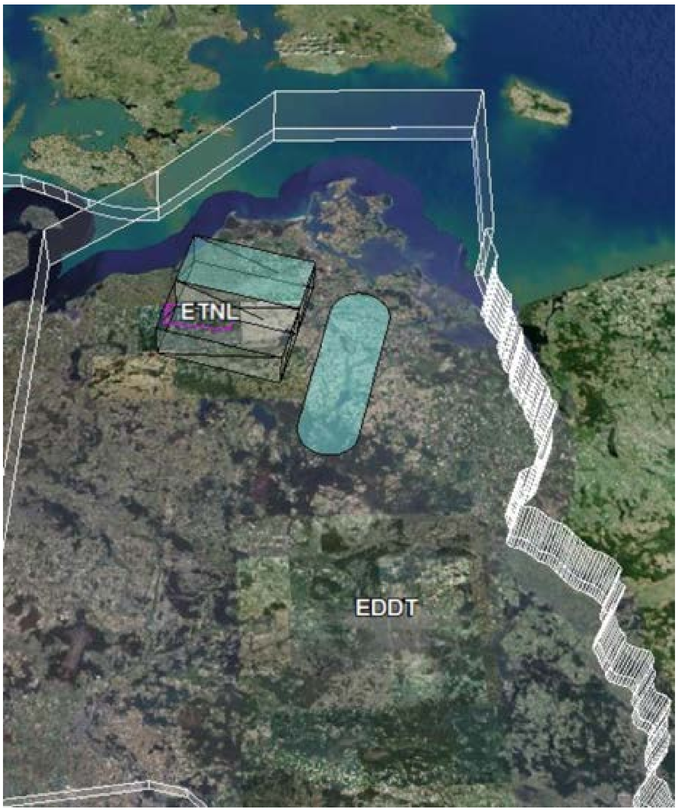


Figure 20: Airspace reservations AMC Germany RS01

AMC Poland

Develops the AUPs for execution of military aerial activities, based on the planning of Polish AF:

1) The Polish Air Forces Siły Powietrzne plan to execute standard manoeuvring training for their Malbork Air Base (EPMB) MiG29 fighters. The training consists of:
   - Basic Fighter Manoeuvring (BFM);
   - Air to Air Refuelling (AAR);
   - Air Combat Training (ACT).
2) Polish AF tactical scenario:

Four MiG29 execute BFM manoeuvring training for 30 minutes. After that, they join a KC135 tanker for 60 minutes to perform AAR training and refuelling. After refuelling KC135 returns to base and the four MiG29 perform Air Combat Training (ACT) with fourF16 for 30 minutes.

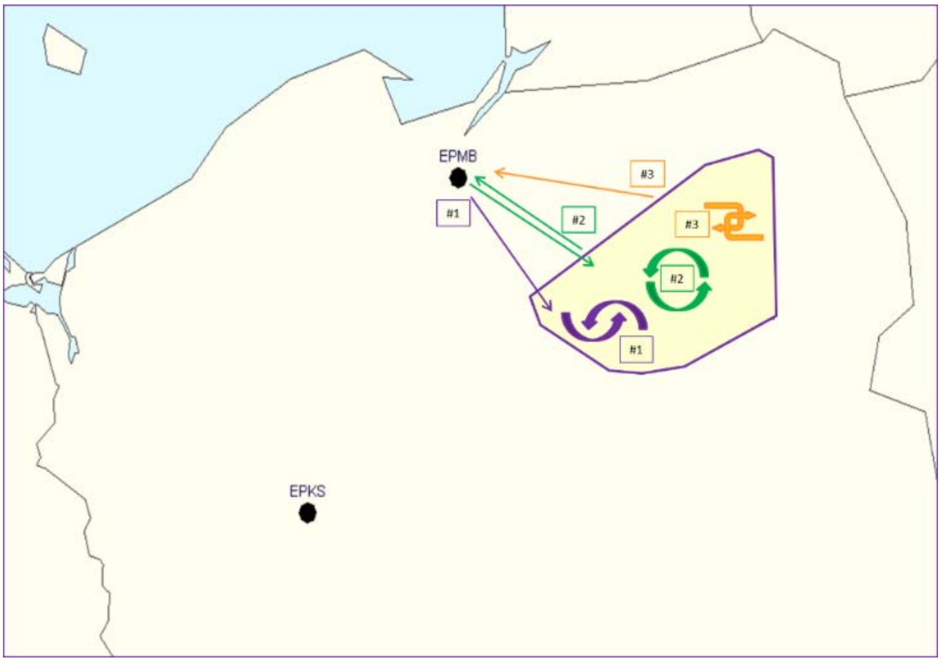


Figure 21: Mission planning Poland RS01

3) Airspace reservations:

For the purpose of the training Polish AMC reserves EP TSA 02 B, C, D, which will be activated from FL115 to FL365 for BFM and AAR, and from FL115 to FL465 for the ACT training.

Airspace	VALIDITY		FL MIN	FL MAX	ACTIVITY	UNIT	Number a/c
EP TSA 02 B, C, D	08:00	08:30	115	365	BFM	EPMB	4xMiG29
EP TSA 02 B, C, D	08:30	09:30	115	365	AAR	EPMB	4xMiG29 1xKC135
EP TSA 02 B, C, D	09:30	10:00	115	465	ACT	EPMB	4xMiG29 4xF16

Table 32: Airspace reservations RS01 AMC Poland

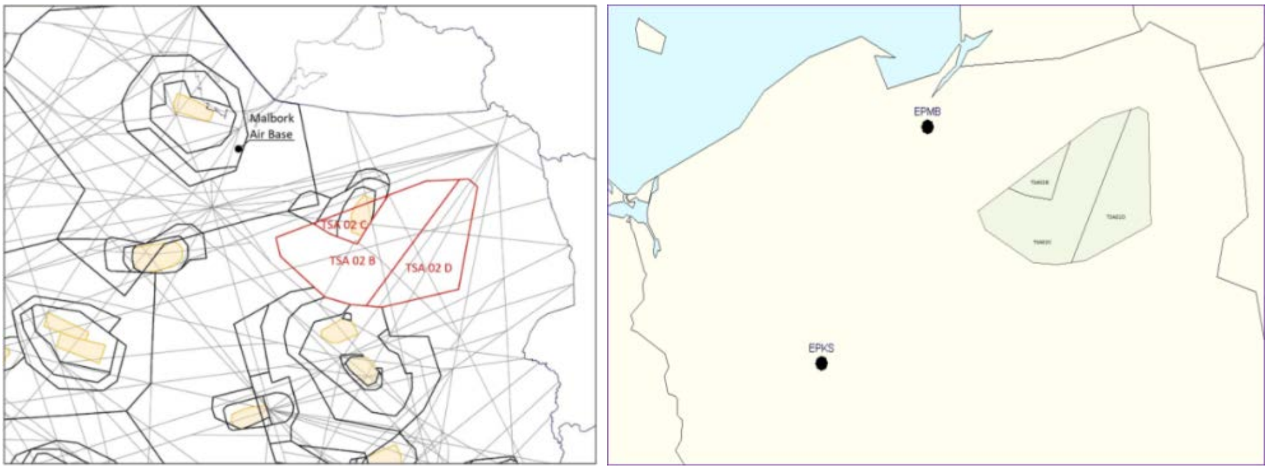


Figure 22: Airspace reservations AMC Poland RS01

5.2.4.2.2 SCN-08.01.02-VALP-0002 Reference scenario 2 Extensive military activities (RS02)

The operational RS02 story is as follows:

5.2.4.2.2.1 Civil part of RS02

The same environment as in RS01 will be used for this reference scenario:

- The current German airspace sectorisation and configurations
- The Polish study to implement FRA environment
- Civil traffic using flight plan demand augmented with STATFOR forecasts for 2023 and adapted in the Polish area to FRA environment.
- R-NEST ICO opening scheme optimizer will be used to define the best sector configurations to be used.

5.2.4.2.2.2 Military part of RS02

In RS02 the Military AUs are planning an execution of two air force exercises, conducted by German and Polish air forces within their respective national airspace with high intensity of sorties, complex mission objectives, usage of large size of volumes of airspace and coordination at national and network levels. The military activities are close to the German – Polish border and coincide in time, although they are not tactically linked. Nevertheless exchange of information between the German and Polish AMC will be exchanged.

The participating military AUs submit independently from each other their airspace requests to their local AMCs, described in the following sections.

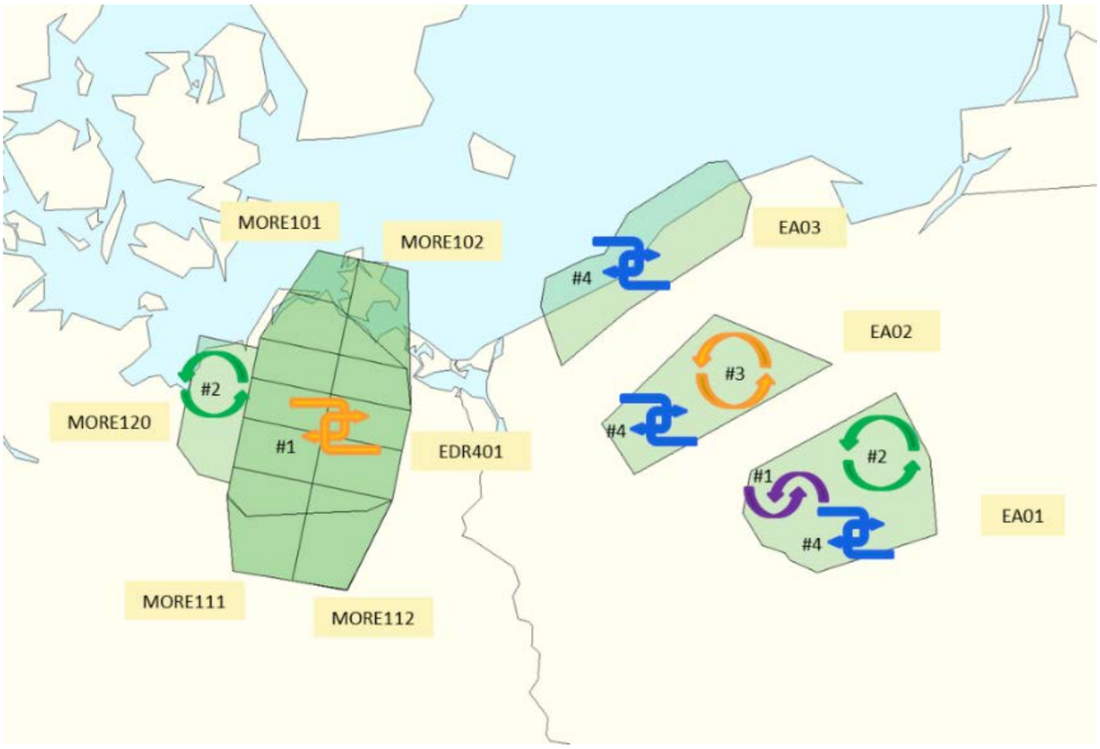


Figure 23: Geographical scope of military missions in RS02

AMC Germany

Develops the AUPs for execution of military aerial activities, based on the planning of GAF.

1) The GAF Luftwaffe plan to execute missions for a monthly recurring major exercise.
2) GAF tactical scenario:

Two squadrons (8xEUFI Eurofighter and 8xTOR Tornado) take off from AFB Laage to the exercise area MVPA North East. The exercise is planned to be conducted in the time window 08:00–11:00. For the first part of the exercise 08:00 – 09:00 the whole MVPA plus its extensions at its Northern and its Southern border (MORE 111 and 112 areas) are activated.

The exercise is supported by a tanker A310 for AAR, which is performing refuelling of participating a/c in formations of four fighters. At 08:45 the tanker is planned to arrive in AAR anchor MERLE (MORE120). The AAR commences at 09:00 until 10:00. This AAR activity is in parallel to the exercise taking place in the rest of the MVPA areas. From 09:00 the exercise area is reduced to BASIC1all and 2all.

#	Airspace	VALIDITY		MIN	MAX	ACTIVITY	UNIT	Number a/c
1	ED-R401	08:00	11:00	100	660	INT	ETNL/ETNS	8xEUFI 8xTOR
	MORE111 MORE112	08:00	09:00	350	450			
2	MORE 120	08:30	10:15	160	220	AAR	EDDK	1xA310 4x4 a/c

Table 33: Missions planning RS02 Germany

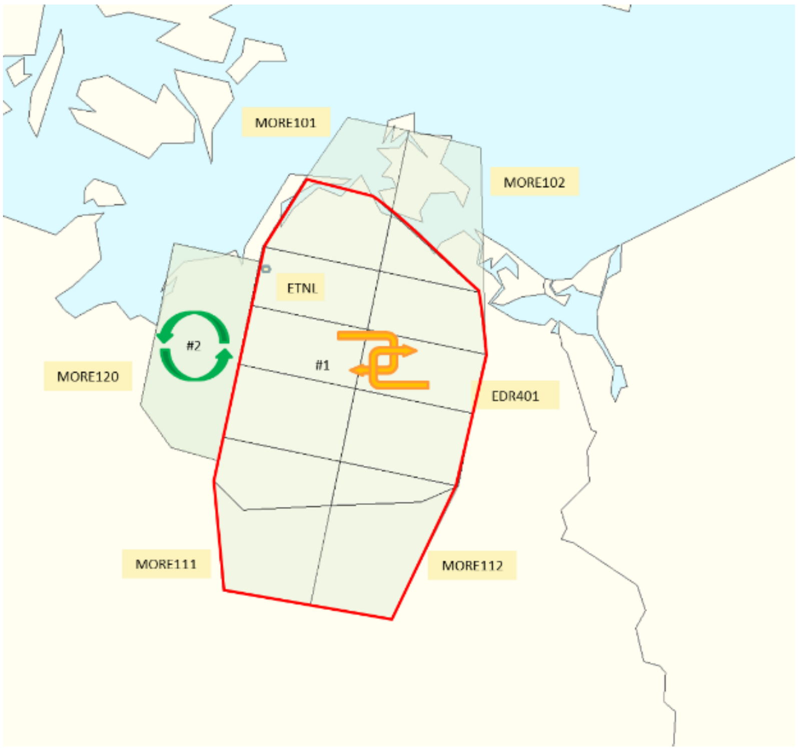


Figure 24: Mission planning 08:00–09:00 Germany RS02

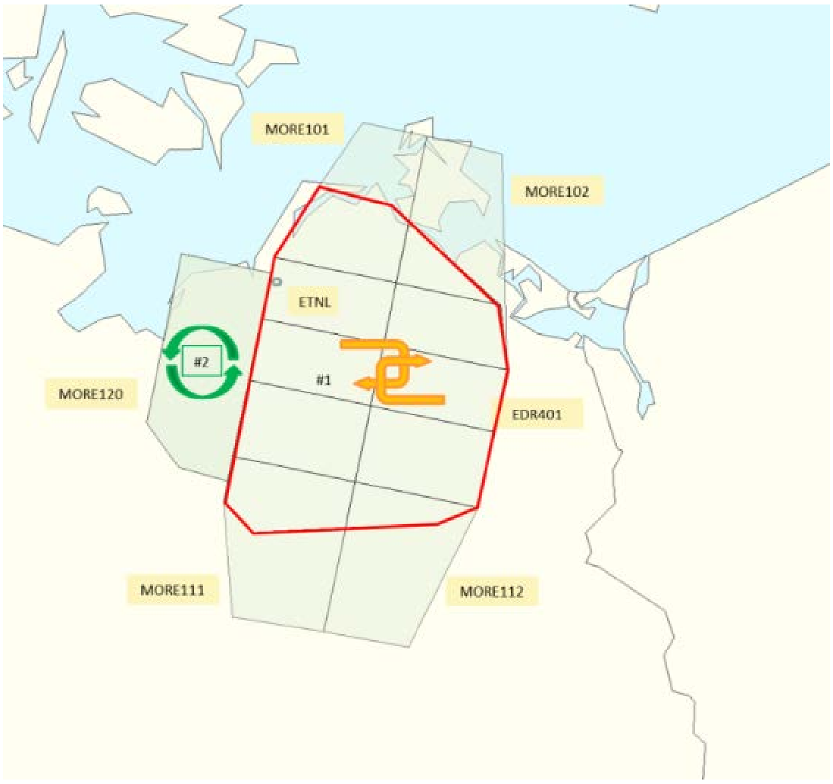


Figure 25: Mission planning 09:00–11:00 Germany RS02

3) To execute the exercise GAF request the following airspace reservations:

ARES 1:

Airspace	VALIDITY		MIN	MAX	ACTIVITY	UNIT	Number a/c
ED-R401 BASIC 1A-E	08:00	11:00	100	660	INT	ETNL/ETNS	8/EUFI 8/TOR
ED-R401 BASIC 2A-E	08:00	11:00	100	660	INT	ETNL/ETNS	8/EUFI 8/TOR

ARES 2:

Airspace	VALIDITY		MIN	MAX	ACTIVITY	UNIT	Number a/c
MORE111	08:00	09:00	350	450	INT	ETNL/ETNS	8/EUFI 8/TOR
MORE112	08:00	09:00	350	450	INT	ETNL/ETNS	8/EUFI 8/TOR

ARES 3:

Airspace	VALIDITY		MIN	MAX	ACTIVITY	UNIT	Number a/c
ED-R401 MORE 120	08:30	10:15	160	220	AAR	EDDK	1/A310 X/MIX

Table 34: Airspace reservations RS02 AMC Germany

Figure 26: Airspace reservations AMC Germany RS02

AMC Poland

Develops the AUPs for execution of military aerial activities, based on the planning of Polish AF:

1) The Polish Air Forces Siły Powietrzne plan to execute international military exercise involving Krzesiny Air Base (EPKS). The training consists of three parts:
   - Basic Fighter Manoeuvring (BFM);
   - Air to Air Refuelling (AAR);
   - Air Combat Training (ACT).
2) Polish AF tactical scenario:

A total of 25 aircraft participate in the exercise (1xAWACS, 2xKC135, 8xF16, 8xEurofighter, 6xMig29).

The exercise begins with BFM in EA 01 for 40 minutes. A formation of 8xF16 and 8xEurofighter participate in this part. It is followed by 60 minutes of AAR in EA 01 and EA 02 (2xKC135 are joining). The third part consists of ACT in EA 01, 02, 03 for 40 minutes. A formation of six Mig29 fighters is joining for the third part.

The tankers are returning to the base.

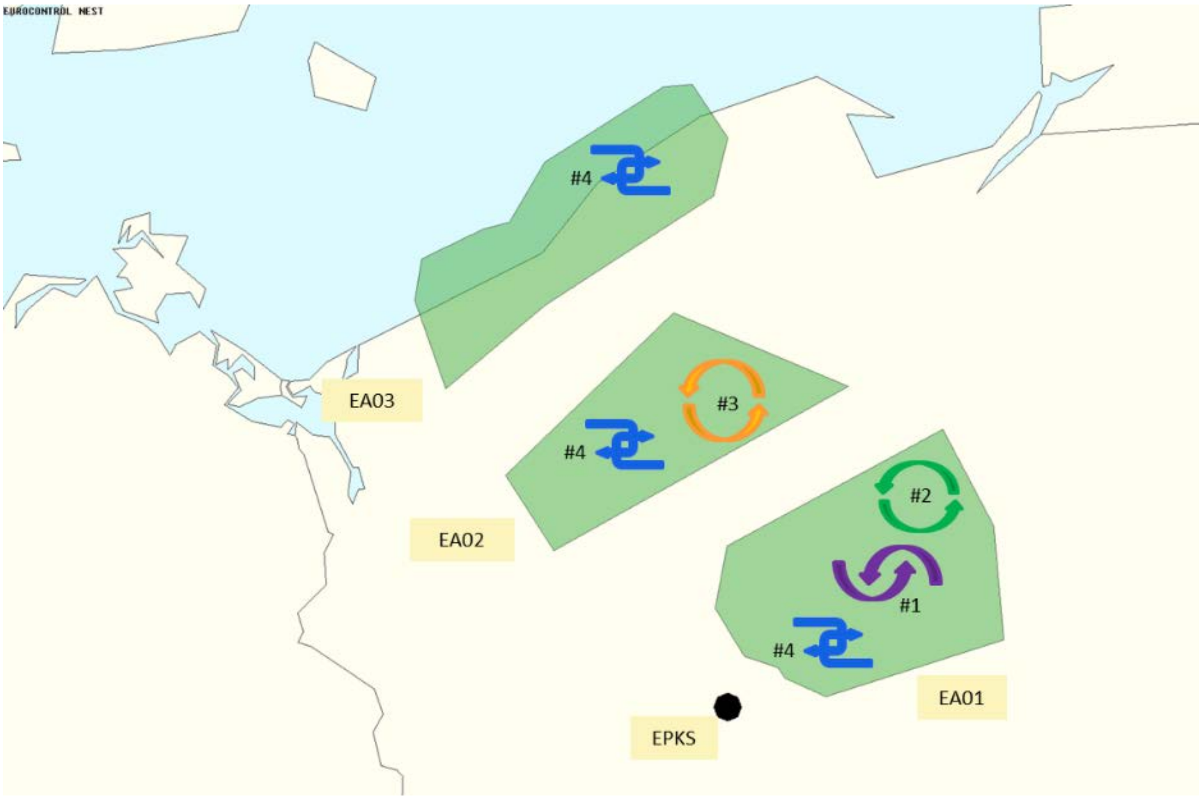


Figure 27: Mission planning Poland RS02

3) Airspace reservations:

Exercise cannot take place in TSAs published in AIP due to their insufficient upper limits. The airspace needed for the exercise consists of following ARES (exercise areas):

- EA 01 based on EP TSA 08 horizontal limits;
- EA 02 based on EP TSA 09 horizontal limits;
- EA 03 based partially on EP TSA 12 and EP TSA 14 horizontal limits.

Airspace	VALIDITY		FL MIN	FL MAX	ACTIVITY	UNIT	Number a/c
EA 01	10:00	10:40	135	365	BFM	EPKS	8xF16 8xEUFI
EA 01	10:40	11:40	245	325	AAR	EPKS	8xF16 1xKC135
EA 02	10:40	11:40	245	325	AAR	EPKS	8xEUFI 1xKC135
EA 01, 02, 03	11:40	12:20	135	365	ACT	EPKS	8xF16 8xEUFI 6xMig29

Table 35: Airspace reservations RS02 AMC Poland

5.2.4.3 Solution Scenarios

The Solution scenarios will be based on a new airspace design built using R-NEST DAC algorithms for Polish airspace and validated by local experts.

New sector configurations will also be defined using R-NEST functionalities. Airspace reservations for military missions will be designed and managed based on DMA types 1 and 2 principles using WOC and R-NEST functionalities (for optimal location and parameters of DMA).

The solution scenarios will collect data for comparison with RSs and assessment of the outcome of the processes in the two models. In addition a Human Performances assessment will be performed to collect expert judgments from the different actors involved in the exercise.

In all military solution scenarios the planning of the missions is presented from the point of view of fighter squadrons' WOC. Therefore, these WOCs are synchronising the missions with tankers but they are not responsible for the planning of tankers missions.

The index for DMAs in Solution scenarios has the following meaning:

ID example	WOC nationality	Sequence of DMA in the mission	Solution scenarios index	Status in the process
G1S11_xxx	**G** - Germany	**1** – the first DMA in the mission for 2xEUFI	**S11** – solution scenario 11	**_xxx** shall contain any additional useful information on the process or the status of the DMA (e.g. SHARED, MODIFIED, APPROVED…etc.}
G2S11_xxx	**G** - Germany	**2** - the second DMA in the mission for 2xEUFI	**S11** – solution scenario 11	
P1S12_xxx	**P** - Poland	**1** – the first DMA in the mission for 4xMiG29	**S12** – solution scenario 12	

Table 36: DMA index legend

5.2.4.3.1 SCN-08.01.02-VALP-1001 Solution scenario 1.1 DAC model A for regular military activities (S11)

5.2.4.3.1.1 Military part of S11

WOC Germany shares the planning for an execution of military aerial activities:

1) GAF missions:

The GAF Luftwaffe plans to execute missions for training of a basic fighter manoeuvring conducted by two Eurofighters interrupted by air-to-air refuelling. The constraining factor in this mission is the time availability of the tanker and mission synchronisation. The mission planning is based on the confirmed AAR slot. Two fighters take-off from AFB Laage to the training area (DMA type 1), defined by WOC and assigned at the end of the CDM process. The fighters proceed to their second assigned DMA (type 2) synchronised with the tanker track, where refuelling is planned for 30 minutes. After refuelling, the fighters proceed to the assigned DMA (type 1) and perform the BFM activity. The tanker returns to base.

2) Airspace reservations and DMAs flexible parameters:

The WOC Germany plans two DMA Type 1 (**G1S11** and **G3S11**) for the BFM activity and one DMA Type 2 (**G2S11**) for the AAR track. The DMAs Type 1 shall have as a reference point ETNL, with distance min 0 NM and distance max from the reference point 70 NM within 360 degree circle. The DMA **G2S11** shall be located from the reference point - the boundary of **G1S11** at a distance min 10 NM and max 30 NM. The flexible parameters provided by WOC are specified in **Table 37**.

Airspace (DMA type1 or type 2)	DMA dimensions NM	Location reference and flexible parameters	DMA time span (minutes)	DMA activation times and dependencies		FL min	FL max	FL band (ft)	Activity	Number a/c
G1S11	40x60	ETNL 360 degree 0 < D < 70 NM	60	08:00	09:00	100	450	18000	BFM	2x EUFI
G2S11	30x45	G1S11 10 < D < 30 NM	30	09:00	09:30	180	350	4000	AAR	1x A310 2x EUFI
G3S11	40x60	ETNL 360 degree 0 < D < 70 NM	60	09:30	11:00	100	450	18000	BFM	2x EUFI

Table 37: DMAs and flexible parameters S11 WOC GER

WOC Poland shares the planning for an execution of military aerial activities:

1) The Polish Air Forces missions

Siły Powietrzne plan to execute standard manoeuvring training for their Malbork Air Base (EPMB) MiG29 fighters. The training consists of:

- Basic Fighter Manoeuvring (BFM);
- Air to Air Refuelling (AAR);
- Air Combat Training (ACT).

Four MiG29 execute BFM manoeuvring training for 30 minutes in DMA type 1 (**P1S11)**. After that, they join a KC135 tanker for 60 minutes to perform AAR training and refuelling in DMA type 2 (**P2S11**). After refuelling KC135 returns to base and the four MiG29 perform Air Combat Training (ACT) with four F16 for 30 minutes in DMA type 1 (**P3S11**).

2) Airspace reservations and DMAs flexible parameters:

The WOC Poland plans two ARES DMA Type 1 (**P1S11** and **P3S11**) and one DMA Type 2 (**P2S11**) with following flexible parameters:

- Airspace will be reserved for total time two hours, ideally 09.00-11.00 UTC. The WOC provides flexibility on that parameter for the time window between 08.30-15.00 UTC.
- The only limitation is that entry airspace and exit airspace should not be further, than 70 NM from Air Base and distance between DMAs should not be greater than 50 NM.
- For DMA Type 1 the WOC requests volumes with dimension of 40x60 NM for the BFM activity, 60x80 NM for the ACT and for the DMA Type 2 - dimensions 30x45 NM for the AAR
- Vertical lower limit should be FL155 or lower and upper limit should be FL335 (for BFM) / FL295 (for AAR) / FL450 (for ACT) or higher.
- All space buffers are included into the DMA dimensions.

The flexible parameters provided by WOC are specified in **Table 38**

Airspace (DMA type1 or type 2)	DMA dimensions NM	Location reference and flexible parameters	DMA time span (minutes)	DMA activation times and dependencies		FL min	FL max	FL band (ft)	Activity	Number a/c
P1S11	40x60	EPMB 0 < D < 70 NM	30	09:00	09:30	155	335	18000	BFM	4xMiG29
P2S11	30x45	P1S11 and P3S11 0 < D < 50 NM	60	09:30	10:30	155	295	4000	AAR	4xMiG29 1xKC135
P3S11	60x80	EPMB 0 < D < 70 NM	30	10:30	11:00	155	450	18000	ACT	4xMiG29 4xF16

Table 38: DMAs and flexible parameters S11 WOC POL

5.2.4.3.1.2 Civil part of S11

Local DAC ATFCM actors and NM will define their daily performance targets. The performance targets should be based on the monitoring of performance targets to identify which of them is critical and therefore should be prioritised. The performance indicators that will be used for the exercise will be route extension and fuel consumption/CO_2 emissions.

The Local DAC ATFCM actors will identify the number of sectors that can be opened for the different period of time based on the available number of ATCOs. A default opening scheme will be built by the local actor to already allow the identification of local hotspots.

The NM collects the number of sectors. Using the most up to date traffic picture and this number of openable sectors, it will identify the optimal sector configurations to be used to match the Local and Network performance targets as well as complex areas, potential overloads or hotspots which will lead to the definition of “ATC volumes”. NM will then share its definition of the ATC volumes.

5.2.4.3.1.3 DAC Management part of S11

In “model A” scenarios, NM plays the key role in the identification of traffic demand and of “critical traffic volumes” with consequent proposals to local DAC ASM function for ideal sector configurations usage and the definition of “ATC volumes”. The “ATC volumes” are shared with WOC to be considered in the definition of D-Ops ARES requests.

The sharing of D-Ops ARES by WOC triggers the CDM process for the adjustments required to both sector configurations and DMA allocation plan as well as the implementation of ATFM measures to fulfil Network performance requirements to a feasible extent while granting adherence to Local performance targets and military requirements. The CDM process is performed at both Local and Network levels under NM coordination.

Information sharing, impact assessments and decision-making are supported by automated tools as described in *5.2.7 Validation Exercise Platform / Tool and Validation Technique*.

Local DAC ATFCM actors and NM define their own Performance targets for the simulated day of operation (local for Local DAC actors and Network wide for NM). These indicators are exchanged between the actors and their consistency check is based on expert’s judgement.

Taking into account the updated D-Ops traffic demand, the NM is proposing the ideal sector configurations for each ACC for the different period of time, the definition of ATC volumes to be de-conflicted with DMA by the local actors, and potential applicable ATFM measures if needed. At local level de-confliction is performed on the basis of local performance targets while respecting the limits of defined ARES flexible parameters.

The result of local coordination triggers CDM with NM resulting in the final version of sector configurations, ARES allocation plan and revised ATFM measures. This marks the completion of S1.

Based upon the judgements of exercise participants, the execution of scenario provides WOC the flexibility to introduce additional requests or changes to the agreed ARES plan, thus triggering a new CDM process at local and network levels for updating sector configurations or ATFCM measures.

<u>Note 1</u>: a detailed description of “model A” DAC management process which will be played in this scenario is provided in the exercise handbook.

<u>Note 2</u>: due to limited efforts available, DFS will only evaluate ARES requests alternatives and will neither assess traffic demand nor try to optimize sector configurations or propose ATFCM measures (local DAC ATFCM role).

5.2.4.3.2 SCN-08.01.02-VALP-1002 Solution scenario 1.2 DAC model A for extensive military activities (S12)

5.2.4.3.2.1 Military part of S12

WOC Germany shares the planning for an execution of military aerial activities:

1) The GAF missions:

GAF plans to execute missions for a monthly recurring major exercise. Military planning for GAF is scoping the following tactical scenario:

Two squadrons (Eurofighter and Tornado) take off from AFB Laage (ETNL) to the exercise area 140x60 NM DMA (type 1), defined by WOC and assigned at the end of the CDM process. The exercise tactical scenario is planned from 08:00 to 11:00.

2) Airspace reservations and DMAs flexible parameters:

The WOC Germany plans one DMA Type 1 (**G1S12**) with the dimension of 140x60 NM from FL 100 up to FL660 for the tactical training activity with a reference point LAG (TACAN) 535512N 0121711E and a distance 0 < D < 70NM between LAG R010 and R170.

The second DMA is Type 2 (**G2S12**) with the dimension of 30x55 NM from FL 160 up to FL220 for the AAR track. The DMA **G2S12** shall be located from the reference point - the boundary of **G1S12** at a distance 0 NM.

At 08:50 the tanker is activating a **G2S12** for AAR and the refuelling commences at 08:50 until 10:00. The AAR activity is performed continuously in formations of four a/c, in parallel with the tactical activities in **G1S12**.

Airspace (DMA type1 or type 2)	DMA dimensions NM	Location reference and flexible parameters	DMA time span (minutes)	DMA activation times and dependencies		FL min	FL max	FL band (ft)	Activity	Number a/c
G1S12	140x60	Ref. point LAG (TACAN) 535512N 0121711E 0 < D < 70NM between LAG R010 and R170	180	08:00	11:00	100	660	56000	INT	8xEUFI 8xTOR
G2S12	30x55	boundary of G1S12 D = 0 NM	70	08:50	10:00	160	220	4000	AAR	1xA310 (continuously in formations of four a/c, in parallel with the tactical activities in DMA G1S12) 8xEUFI 8xTOR

Table 39: Mission planning S12 WOC GER

WOC Poland shares the planning for an execution of military aerial activities:

1) The Polish Air Forces missions

Siły Powietrzne plan to execute international military exercise involving Krzesiny Air Base (EPKS). The training consists of three parts:

- Basic Fighter Manoeuvring (BFM);
- Air to Air Refuelling (AAR);
- Air Combat Training (ACT).

Military planning for Polish AF is scoping the following tactical scenario:

Two formations 8xF16 and 8xEUFI perform as a first part of their mission BFM. After that the two formations refuel in parallel with two tankers in two separate DMAs. The third part of the mission is performing ACT in three separate DMAs. For this part of the military exercise a formation of 6xMiG29 joins the exercise activities.

2) Airspace reservations and DMAs flexible parameters:

The WOC Poland plans the necessary DMAs with the following flexible parameters:

- Time of the exercise is flexible between 08.00 and 16.00 UTC, although it must be set fixed at least 24 hours before the start of the exercise.
- The volumes of airspace needed must be situated within 50 NM from the air base and distances between DMAs also cannot exceed 50 NM.
- For DMA Type 1 the WOC requests volumes with dimension of 90x110 NM for the BFM activity, 110x130 NM for the ACT and for the DMA Type 2 - dimensions 30x45 NM for the AAR
- All space buffers are included into the DMA dimensions.
- The upper limits of all DMAs cannot be lowered. The lower limits can be modified, but for BFM they need to have at least 12000 ft vertical range and for ACT – 20000 ft vertical range. For AAR at least 8000ft vertical range is required.

Airspace (DMA type1 or type 2)	DMA dimensions NM	Location reference and flexible parameters	DMA time span (minutes)	DMA activation times and dependencies		FL min	FL max	FL band (ft)	Activity	Number a/c
P1S12	90x110	EPKS 0 < D < 50 NM between DMA border and ref. point	40	10:00	10:40	135	335	12000	BFM	8xF16 8xEUFI
P2S12	30x45	P1S12 0 < D < 10 NM between DMA border and ref. point	60	10:40	11:40	245	325	8000	AAR	8xF16 1xKC135
P3S12	30x45	P1S12 0 < D < 10 NM between DMA border and ref. point	60	10:40	11:40	245	325	8000	AAR	8xEUFI 1xKC135
P4S12	110x130	EPKS 0 < D < 50 NM between DMA border and ref. point	40	11:40	12:20	135	450	20000	ACT	8xF16

Airspace (DMA type1 or type 2)	DMA dimensions NM	Location reference and flexible parameters	DMA time span (minutes)	DMA activation times and dependencies		FL min	FL max	FL band (ft)	Activity	Number a/c
P5S12	110x130	EPKS 0 < D < 50 NM between DMA border and ref. point	40	11:40	12:20	135	450	20000	ACT	8xEUFI
P6S12	110x130	EPKS 0 < D < 50 NM between DMA border and ref. point	40	11:40	12:20	135	450	20000	ACT	6xMig29

Table 40: Mission planning S12 WOC POL

5.2.4.3.2.2 Civil part of S12

Similar to 5.2.4.3.1.2

5.2.4.3.2.3 DAC Management part of S12

Similar to 5.2.4.3.1.3

5.2.4.3.3 SCN-08.01.02-VALP-2001 Solution scenario 2.1 DAC model B for regular military activities (S21)

5.2.4.3.3.1 Military part of S21

Similar to 5.2.4.3.1.1

5.2.4.3.3.2 Civil part of S21

Local DAC ATFCM actors and NM will define their daily performance targets. The performance targets should be based on the monitoring of performance targets to identify which of them is critical and therefore should be prioritised. The performance indicators that will be used for the exercise will be route extension and fuel consumption/CO_2 emissions.

The Local DAC ATFCM actors will identify the number of sectors that can be opened for the different periods of time based on the available number of ATCOs. In using the most up to date traffic picture and this number of openable sectors, an optimal opening scheme will be built by the local actor. Remaining complex areas, potential overloads or hotspots will lead to the definition of "ATC volumes" by the local DAC actor.

The NM collects the number of sectors, the defined opening scheme by local DAC actors as well as the "ATC volumes". NM will assess the Network situation against its Network performance targets.

5.2.4.3.3.3 DAC management part of S21

In "model B" scenarios, the local level of DAC plays the key role in the identification of traffic demand and of "critical traffic volumes", thus the definition of ideal sector configurations. The "ATC volumes" are defined at local level and shared with WOC to be considered in the definition of D-Ops ARES requests.

The sharing of D-Ops ARES requests triggers a local level CDM process aiming at identifying the configuration which delivers best adherence to local performance targets.

The role of NM is to advise local DAC actor and to coordinate sector configurations and ATFM measures to fulfil as feasible as possible Network performance requirements.

The final configurations of sectors and ARES plan is agreed throughout a CDM process between local DAC and NM actors. This marks the completion of S21.

Information sharing, impact assessments and decision-making are supported by automated tools as described in *5.2.7* Validation Exercise Platform / Tool and Validation Technique

Based upon the judgements of participants, the execution of scenario provides WOC the flexibility to introduce additional requests or changes to the agreed ARES plan, thus triggering a new CDM process at local and network levels for updating sector configurations or ATFCM measures.

Note 1: a detailed description of "model B" DAC management process which will be played in this scenario is provided in the exercise handbook.

Note 2: due to limited efforts available, DFS will only evaluate ARES requests alternatives and will neither assess traffic demand nor try to optimize sector configurations or propose ATFCM measures (local DAC ATFCM role).

5.2.4.3.4 SCN-08.01.02-VALP-2002 Solution scenario 2.2 DAC model B for extensive military activities (S22)

5.2.4.3.4.1 Military part of S22

Similar to section 5.2.4.3.2.1

5.2.4.3.4.2 Civil part of S22

Similar to section 5.2.4.3.3.2

5.2.4.3.4.3 DAC management part of S22

Similar to section 5.2.4.3.3.1 but with a difference in the defined ARES requests sent by the WOCs.

847 ### 5.2.5 Exercise Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
PJ08-A#1	Environment constraints		Weather is not taken into account. The exercise will consider operations in nominal conditions	V2 maturity level, in planning phase	Planning phase	ENV SAF HP				
PJ08-A#2	Workload integrated in DAC design		A predicted workload calculation method is required in the design of the DAC algorithm, in order to efficiently create sectorisation balancing the workload.		Planning phase	HP SAF	PJ08 OSED		PJ08 OSED	
PJ08-A#3	Free Route		Free Route is safe, validated and implemented		Planning phase		PJ08 OSED		PJ06	
PJ08-A#4	Mission Trajectory		DMA are part of the mission trajectory, this concept is validated and implemented. For the purpose of the exercises, DMA will be described as in the PJ08 OSED		Planning phase		PJ08 OSED		PJ07	

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
PJ08-EXE2-A#1	FUA restrictions		No specific FUA restrictions are defined for this exercise. During activation of areas no traffic is allowed to cross	Limitation of the current tools.	Planning phase		PJ08 OSED		PJ08	

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5.2.6 Limitations and impact on the level of Significance

The potential limitations of EXE-08.01-V2-VALP-002 could come from the validation tools, not allowing or partially allowing some configuration assessment, as explained by the following issues, arisen during the preparation of the exercise:

- Network impact evaluation is limited regarding the number of UAC/ACC(s) considered in the scenario. The impact is that results will be more qualitative (based on Experts' judgment) than quantitative.
- With regard to the metrics calculated by R-NEST, the occupancy count seems to better represent the possible overload of ATCOs, whereas the choice of workload value may undervalue the real workload induced. This is because it does not seem to reflect the complexity of the management of separations between climbing and descending flights typical of intermediate sectors (overflights), compared to those occurring in lower sectors (where arrival and departure paths are generally separated) and upper sectors (almost entirely dedicated to manage levelled traffic). The resulting impact is that real workload might be sometimes under-evaluated.
- The current DAC algorithms only allow for the generation of the following identified elements of dynamicity in the OSED: "Elementary sectors" and "Airspace volumes". The "flexible boundaries" and "SAB" elements cannot currently being automatically generated by the DAC algorithms; they need to be defined manually based on expert's judgment and thus the associated technical feasibility still need to be proved.
- The optimization criteria used for "optimized" computation of sector default configurations (or alternatives) or DMA location is not using the Local or Network performance targets as defined in the concept but the minimum overload of sectors (for sector configurations) or the minimum number of civil impacted flights (for optimal DMA locations). However, after an optimization process or the definition of an alternative solution, the performance indicators associated to the solution are computed and checked against the defined local or Network performance targets. If indicators are closer to the targets, the solution is kept otherwise it's discarded. The impact is that the solutions are not always the most optimal regarding the performance targets but only solutions improving the performance targets are kept.
- The initial assessment of the feasibility and usability of automated tool functionalities for automation of new airspace design (validation objective: EX2-OBJ-08.01-V2-VALP-TF1-002) will be completed based on a single, time-limited exercise using a single traffic sample with a limited number of sector configurations. Hence, the results of the assessment may be not fully representative and significant from a statistical point of view but it will provide a reasonable tendency on this validation objective. Given these limitations, it is imperative that any conclusions on the feasibility and usability of such automated tool functionalities based on this exercise are treated as preliminary and that the reader understands that these are subject to change. However, we are still under V2 maturity level and the exercise on this subject (as on others such as workload for instance) will be complemented by other exercises within the validation roadmap.

5.2.7 Validation Exercise Platform / Tool and Validation Technique

The tools involved in the validation exercise are:

- **R-NEST** (Research Network Strategic Tool): R-NEST is a model-based simulation tool, sharing the same base as the EUROCONTROL NEST tool. R-NEST is EUROCONTROL integrated validation tool combining advanced dynamic ATFCM capabilities with powerful airspace design and capacity planning analysis functionalities. It offers powerful scenario-based modelling engine to simulate ATM network operations, detect and observe various types of delays, identify and dynamically resolve demand vs capacity imbalances over the network, use concepts such as STAM, create dynamic airspace sectorisation using new algorithms and measure performance improvements of new ATM concepts on a network level. The ICO analyser is part of R-NEST and allows optimising the ACC configuration opening scheme to balance controller usage with overloads using a customizable optimisation strategy. The ICO analyser displays the opening scheme and corresponding controller usage and overload indicators before and after applying the optimisation strategy.

For the scope of PJ.08-01 validation exercises, enhancements have been performed:

- Integration of SAGA/COBOS algorithms;
- Extent of ICO analyser design and analysis functionalities to sector configurations composed of DAC elements (SBBs and SAMs) to allow more dynamicity of the ACC configuration opening scheme;
- What if function for DMA has been developed that enable to assess the impact of DMA location on the civil trajectories;
- Automated optimised location for DMAs by the tool ;
- Mission Trajectory (MT) implementation (initial backbone structure);
- Integration of BADA for fuel consumption evaluation.

- **INNOVE** (INtegrated Network Operations Validation Environment): INNOVE is a virtual replica of EUROCONTROL NM and used as a V2 validation platform providing interactive gaming and allowing execution of bespoke scenarios which can be loaded and executed either in real-time or in static modes to provide a realistic emulation of the Network Manager B2B SWIM services. INNOVE emulates many of the NM B2B services in particular:

  - Flight Management Services
  - Flight Filing Services (but limited to a subset of NM services)
  - Airspace Services to support Traffic Volume management and Sector configuration plans
  - Runway configuration management services
  - Flow services to manage Hotspot Plans in line with the NM20.0, 20.5 & 21.0 methodology
  - Traffic Count services and alerts
  - Flow services for the management and update of Regulation/Reroute Measures
  - M-CDM Services to support the collaborative STAM modelling process for gaming scenarios
  - Publish / Subscribe messaging services (direct through AMQP messaging and via SOAP if required)
  - Modelling of the NM Unit/ANU-ID process

Currently the models and functions that are connected with INNOVE include:

- R-NEST-CASA components and the application of the True Revision Process (TRP) to model how NM uses Regulations and Departure constraints (Slots) in support of Demand Capacity Balancing (DCB)
- ATC Simulation components including Flight Feedback messaging services using the RAMS Plus ATC & Airport Simulator to support ATC operation modelling
- Airport Operations Centre (APOC) modelling using the ATHOS simulation platform from Airbus
- Simplified UDPP client application

- EUROCONTROL FMP client application
- EUROCONTROL Flight Operations Centre client application

For the scope of PJ.08-01 validation exercises, enhancements have been performed:

- Development of Airspace services to integrate ARES reservation with DMAs and the definition of ATC volumes as defined in PJ08 OSED
- Gateway with R-NEST to provide access to DAC algorithms modules (SAGA and COBOS), ICO module for opening schemes optimization, and DMA optimal location module
- Development of simulation datasets for multiple what-if
- Development of KPI metrics.

- **CAT** (Common Airspace Tool): is a support system for both pre – tactical and tactical levels of AMC.

  The system is used to collect information on long term airspace planning, negotiation and consolidation of reservations, tactical activation and deactivation of structures and distribution of the airspace allocation plan (AUP/UUP). CAT also can be used to redistribute the gathered information to users via B2B with NM or other external systems.

  Detected spatial and temporal conflicts between airspace structures are addressed via civil – military cooperation to ensure that the CDM process between all involved operational stakeholders complies with local/regional rules.

  CAT also supports the FRA environment. The operators can manage reservations including areas with FBZ and associated FUA/EU restrictions.

  SESAR CAT supports CDM process between WOC and local DAC (AMC and ATFCM) regarding DMA allocation. System collects users' requests for DMAs, then based on historical GAT flows and planned ACC sectorisation, helps users to find the most suitable location for DMA location, to minimise impact on civil traffic and capacity.

- **STANLY_POS** (Statistics and Analysis positioning tool): The already existing prototype of an ASM tool will act as an optimizer that polls flow and sector data from the centralized service via B2B and the DMA reservation request. STANLY_POS will analyse both data set and computes suggested DMA positions in the order of affected civil traffic. POS will reply to the requesting partner with these suggested DMA shapes and positions. The reference scenario will be supported by STANLY ACOS, the DFS ASM tool used for AUP and UUP creation.

- **WOC ASM** (Wing Operation Centre – AirSpace Management): WOC ASM is a module of the WOC prototype dedicated to ARES management and negotiation. It aims at supporting the selection/definition of appropriate ARES to enable specific military peace time Air Operation and especially operational training. It enables the operator to enter its criteria (size, shape, etc.) and requirements (distance, timing, etc.) to identify or define the proper Area that comply with the operational objectives. The added value of the tool is to provide automatically airspace corresponding to the criteria/requirements and:

  - Minimizing the potential conflicts with the air traffic planned at that time,
  - Avoiding any conflict with the ATC volumes.

  In the frame of the PJ08.01, the following improvements have been introduced:

  - DMA T1 and T2 are implemented
  - De-confliction with Airspace (ATC volumes) that are to be avoided

- Shape can be modified by the operator
- Sequence of the ARES use in the Mission Trajectory
- Rough trajectory to join the DMAs and the Airbase
- Calculation of the Mission efficiency (Operational use of the ARES/Total mission duration)
- Negotiation of the ARES
- Interface with INNOVE to:
  - get civil data and constraints
  - perform AAM civil – military negotiation

5.2.7.1 Validation Exercise Platform / Tool characteristics

V&V Platform Name		EUROCONTROL: R-NEST modelling platform
A.1.1	It is a new developed V&V platform?	NO.
A.1.2	If yes, which are the reasons supporting the development of a new platform?	Not applicable
A.2	It is the first time to be used for a SESAR validation exercise	NO. It has been already used during SESAR I validation sessions and by exercises VP-08.01-01 and VP-08.01-04.
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	NO, but the platform has been customised for VP-08.01-01, VP-08.01-04 and VP-08.01-02. For the purpose of VP-08.01-02, new features have been added: enhancement of the batch functionalities by providing access to new functionalities for linking with INNOVE platform. Improvement of the DMA optimal location module (new constraints such as bearing start/end, ATC volumes, no overlap with other DMAs). Improvement of the sector configuration building tool.
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	The strategic phase of DAC as developed in PJ08 OSED: automated support for airspace design using traffic demand, dynamic sector configurations definition, optimal location of DMAs.
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	Building of new airspace design using DAC algorithms, definition of optimized dynamic sector configurations and opening schemes. Computation of optimal location for DMA.
D	Which validation methods can be used on the new V&V Platform?	Real time and gaming platform

V&V Platform Name		EUROCONTROL: INNOVE
A.1.1	It is a new developed V&V platform?	NO.
A.1.2	If yes, which are the reasons supporting the development of a new platform?	Not applicable
A.2	It is the first time to be used for a SESAR validation exercise	NO. It has been already used during SESAR I validation sessions and in SESAR 2020 for PJ08, PJ09 and PJ07 exercises.
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	NO, but new functionalities have been developed for ARES requests using DMAs, definition of ATC volumes, making the link to R-NEST to use DAC algorithms and optimal DMA location modules, etc. (see INNOVE section in 5.1.7)
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	New airspace service for ARES requests using DMAs and CDM process with Local DAC, WOC and NM actors.
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	The platform will, in particular, support the CDM process and information sharing between different actors (WOC, Local DAC & NM).
D	Which validation methods can be used on the new V&V Platform?	Fast time and gaming simulations.
V&V Platform Name		**PANSA: CAT**
A.1.1	It is a new developed V&V platform?	No, however DAC functionalities developed in the system for this exercise are part of an important upgrade of CAT.
A.1.2	If yes, which are the reasons supporting the development of a new platform?	Not applicable
A.2	It is the first time to be used for a SESAR validation exercise	Yes
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	Yes. New functionalities have been developed, to support the CDM process between AMC and FMP regarding DMA Type 1 and Type 2 allocation. In order to enable coordination with NM and military side, interoperability with INNOVE B2B services has been added.
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	The scenarios to be validated include the Civil-Military collaborative decision making process for the negotiation of the DMAs, new airspace service for DMA requests and CDM process with NM and WOC.
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	The platform collects users' requests for DMAs, then based on historical GAT flows and planned ACC sectorisation, helps both AMC and FMP users to find the most suitable DMA location, to minimise the impact on the civil traffic and sectors capacity. Additionally, thanks to its B2B connection it supports the CDM process and

		information sharing between different actors (WOC, Local DAC & NM).
D	Which validation methods can be used on the new V&V Platform?	Gaming Simulation
V&V Platform Name		**DFS: STANLY_POS**
A.1.1	It is a new developed V&V platform?	No, it is a prototype that was already used for traffic impact analysis in conjunction with STANLY ACOS
A.1.2	If yes, which are the reasons supporting the development of a new platform?	Not applicable
A.2	It is the first time to be used for a SESAR validation exercise	Yes, DMA calculation was not performed in any SESAR validation activity by DFS tools yet.
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	Yes, see above
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	STANLY_POS aims to prove the DMA concept of operations by means of calculating the best possible 4D object for a military training area that has least impact on civil traffic.
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	The STANLY_POS system will calculate the ideal shape, horizontal and vertical position of a DMA as requested by WOC tool.
D	Which validation methods can be used on the new V&V Platform?	Gaming Simulation
V&V Platform Name		**AIRBUS: WOC ASM**
A.1.1	It is a new developed V&V platform?	No, it is an important upgrade of an existing mock-up aiming at illustrating the new Airspace Management concept for military.
A.1.2	If yes, which are the reasons supporting the development of a new platform?	Not applicable
A.2	It is the first time to be used for a SESAR validation exercise	Yes.
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	Yes. New functionalities have been developed: they are related to DMA Type 1 and Type 2 specific characteristics. Furthermore interoperability with INNOVE B2B services has been added in order to enable the Military-Civil negotiation.
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	Military will ask for some ARES (ref scenario: existing fixed area and AAM scenario: DMA Type 1 and Type 2) that are depending to each other in order to build a full training air operation. The comparison between the 2 scenarios will

		enable to identify lessons learnt and compare the mission efficiencies. The scenario includes the Military-Civil collaborative decision making process for the negotiation of the ARES.
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	Mission efficiency will be measured by calculating the ratio: Operational use of the ARES / Total mission duration. Military-Civil collaborative decision making process for the negotiation of the ARES.
D	Which validation methods can be used on the new V&V Platform?	Gaming Simulation

Table 42: Validation Exercise EXE-08.01-V2-VALP-002 Platform/Tool characteristics

5.2.7.2 Architectural view: mapping Validation Infrastructure and SUTs onto EATMA

V&V Platform Name		**EUROCONTROL: R-NEST**
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	ASM. ATFCM.
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	Cooperative Airspace Design. Cooperative Airspace Management. Cooperative Scenario Planning.
V&V Platform Name		**EUROCONTROL: INNOVE**
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	ASM. ATFCM.
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	Cooperative Airspace Management. Cooperative Scenario Planning.
V&V Platform Name		**PANSA: CAT**
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	ASM. ATFCM (partially).
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	Cooperative Airspace Management.
V&V Platform Name		**DFS: STANLY_POS**
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	DFS will use STANLY_POS prototype for the data exchange with INNOVE and the computing of an ideal DMA. STANLY_ ACOS will be used for the reference scenario (VPA, CDR closures).

B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	Cooperative Airspace Management.
V&V Platform Name		**AIRBUS: WOC ASM**
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	ASM.
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	Cooperative Airspace Management.

Table 43: Validation Exercise EXE-08.01-V2-VALP-002 Platform / Tool mapping onto EATMA

5.2.7.3 Validation Exercise Technique

EXE-08.01-V2-VALP-002 is a gaming exercise supported by fast-time simulation techniques in order to collect quantitative data and cover the validation objectives.

The tools involved in this validation exercise are:

- **R-NEST** (Research Network Strategic Tool): R-NEST is EUROCONTROL integrated validation tool combining advanced dynamic ATFCM capabilities with powerful airspace design and capacity planning analysis functionalities. R-NEST offers powerful scenario-based modelling engine to simulate ATM network operations, detect and observe various types of delays, identify and dynamically resolve demand vs capacity imbalances over the network, use concepts such as STAM, create dynamic airspace sectorisation using new algorithms and measure performance improvements of new ATM concepts on a network level. For this exercise, it especially provides access to the DAC algorithms to other tools.
- **INNOVE** (INtegrated Network Operations Validation Environment): INNOVE is a virtual replica of EUROCONTROL NM and used as a V2 validation platform providing interactive gaming and allowing execution of bespoke scenarios which can be loaded and executed either in real-time or in static modes to provide a realistic emulation of the Network Manager B2B SWIM services.
- **CAT** (Common Airspace Tool) CAT2020 is a module of the local ASM supporting system dedicated to support both pre – tactical and tactical levels of ASM. It supports CDM process between WOC and local DAC (ASM and ATFCM) regarding DMA allocation. System collects users requests for DMAs, then based on historical GAT flows and planned ACC sectorisation, helps the user to take the decision regarding the DMAs location to minimize impact on civil traffic and ACC sectors capacity.
- **STANLY_POS** (Statistics and Analysis positioning tool): The already existing prototype of an ASM tool will act as an optimizer that polls flow and sector data from the centralized service via B2B and the DMA reservation request. POS will analyse both data set and computes suggested DMA positions in the order of affected civil traffic. POS will reply to the requesting partner with these suggested DMA shapes and positions. The reference scenario will be supported by STANLY_POS_ACOS, the DFS ASM tool used for AUP and UUP creation.
- **WOC ASM** (Wing Operation Centre – AirSpace Management): WOC-ASM is a module of the WOC prototype dedicated to ARES management and negotiation. It aims at supporting the

selection/definition of appropriate ARES, including DMA Type 1 and 2 to enable specific military peace time Air Operation and especially operational training. It enables the operator to enter its criteria (size, shape, etc.) and requirements (distance, timing, etc.) to identify or define the proper Area that comply with them. It enables to link the ARES with the rough mission trajectory.

The selected validation technique is a gaming exercise using a simulation platform composed by EUROCONTROL INNOVE & R-NEST simulators (used by NM actor), PANSA's CAT (used by Local DAC ASM & ATFCM actors) and DFS's STANLY_POS Airspace Management tools (used by Local DAC ASM actor) and AIRBUS's WOC ASM tool (used by the WOC actor).

Gaming technique is an appropriate technique for validating operational feasibility and is appropriate to the exploration of real-life situations where two or more parties must interact with a choice of action in order to meet their objectives. It will allow to validate the DAC Management processes (and the associated CDM processes), to assess the technical feasibility of the supporting tools as well as the exchange of information between the different actors' tools.

This validation technique has been considered the most suitable to address validation objectives for EXE-08.01-V2-VALP-002 exercise.

Site of the exercise

The validation exercise will take place both at the EUROCONTROL Experimental Centre (EEC), located in Brétigny-sur-Orge, France.

5.2.8 Analysis Specification

5.2.8.1 Data collection methods

This section provides an overview of the data collection methods to obtain the data to be used in the post-execution activities to calculate the metrics and indicators defined for this validation exercise.

EXE-08.01-V2-VALP-002 will provide qualitative and quantitative data. Qualitative data will be acquired in the exercise through user/operator feedback from and will be obtained through appropriate questionnaires. Quantitative data through objective measurements will be obtained as outputs from R-NEST, INNOVE or WOC ASM tools, and will be recorded during each run.

Exercise Validation Objective	METRICS/KPI	Data collection method
EX2-OBJ-08.01-V2-VALP-PE1-001	**CAP2:** En-route throughput per unit time **Unit:** Relative change of movements (% and number of movement). **Calculation:** number of movements per volume airspace per hour (occupancy counts).	**Quantitative output from INNOVE**
EX2-OBJ-08.01-V2-VALP-PE1-002	**PRD1:** Variance of Difference in actual & Flight Plan or RBT durations. **Unit:** Minutes **Calculation:** difference of actual & Flight Plan or RBT durations.	**Quantitative output from INNOVE**

Exercise Validation Objective	METRICS/KPI	Data collection method
EX2-OBJ-08.1-V2-VALP-PE1-003	**CEF2:** Flights per ATCO-Hour on duty **Unit:** Nb **Calculation:** Count of Flights handled divided by the number of ATCO-Hours applied by ATCOs on duty.	**Quantitative output from INNOVE / R-NEST**
EX2-OBJ-08.01-V2-VALP-PE1-004	**SAFETY:** N° of conflicting SBT/RBTs in reference and solutions scenarios **Unit:** Nb of conflicts **Calculation:** Variation in conflicts linked to BTs modifications of civil flights and civil/military flights.	**Quantitative output from R-NEST**
EX2-OBJ-08.01-V2-VALP-PE1-005	**FEFF1.1:** Planned Average fuel burn per flight **Unit:** Kg fuel per movement **Calculation:** Total amount of fuel burn divided by the number of movements.	**Quantitative output from INNOVE / R-NEST**
EX2-OBJ-08.01-V2-VALP-PE1-005	**FEFF2:** CO_2 Emissions **Unit:** Kg CO_2 per movement **Calculation:** Amount of fuel burn x 3.15 (CO_2 emission index) divided by the number of movements.	**Quantitative output from INNOVE / R-NEST**
EX2-OBJ-08.01-V2-VALP-PE1-005	**FEEF3:** Reduction in average flight duration **Unit:** Minutes **Calculation:** Average actual flight duration measured in the Reference Scenario – Average flight duration measured in the Solution Scenario.	**Quantitative output from INNOVE**
EX2-OBJ-08.01-V2-VALP-PE1-006	**CMC1.1:** Available/Required training Duration within ARES **Unit:** minutes **Calculation:** Difference between end activation time and start activation time.	**Quantitative output from WOC ASM**
EX2-OBJ-08.01-V2-VALP-PE1-006	**CMC1.2:** Allocated/ Optimum ARES dimension **Unit:** 3D dimensions **Calculation:** Volume computed with shape coordinates and FL min and FL max.	**Quantitative output from INNOVE / R-NEST / WOC ASM**
EX2-OBJ-08.01-V2-VALP-PE1-006	**CMC1.3:** Transit Time to/from airbase to ARES **Unit:** Minutes **Calculation:** Total airborne time outside DMA(s) (based on mid-speed).	**Quantitative output from WOC ASM**
EX2-OBJ-08.01-V2-VALP-PE1-006	**CMC1.3-1:** time spent in DMA(s) versus total mission time **Unit:** % **Calculation:** Ratio between times spent in DMA(s) versus total mission time (based on mid-speed).	**Quantitative output from WOC ASM**
EX2-OBJ-08.01-V2-VALP-PE1-007	**Indicator:** Compliance with Local Performance targets **Unit:** depends on target **Calculation:** difference between target and actual	**Quantitative output from INNOVE**

Exercise Validation Objective	METRICS/KPI	Data collection method
EX2-OBJ-08.01-V2-VALP-PE1-008	**Indicator:** Compliance with Network Performance targets **Unit:** depends on target **Calculation:** difference between target and actual	**Quantitative output from INNOVE**
EX2-OBJ-08.01-V2-VALP-TF1-001	**HP2 Suitability of technical system in supporting the tasks of human actors:** - Identification of research prototype further requirements needs, if any for: * Automated tools * Network Manager tools * Local DAC tools * DAC Algorithms * DMA location tools	**Questionnaires and expert judgement**
EX2-OBJ-08.01-V2-VALP-TF1-002	**HP2 Suitability of technical system in supporting the tasks of human actors:** - Operator's feedback on DAC tools on the usability of automated support for the decision making process assessing and for comparing different airspace configurations based on complexity. * Automated tools * Network Manager tools * Local DAC tools * DAC Algorithms * DMA location tools	**Questionnaires and expert judgement**
EX2-OBJ-08.01-V2-VALP-OF1-001	**HP1 Consistency of human role with respect to human capabilities and limitations** - Operator's feedback on workload associated with the tasks - Operator's feedback on situational awareness - Operator's feedback on the degree of flexibility provided	**Questionnaires and expert judgement**
EX2-OBJ-08.01-V2-VALP-OF1-002	**HP1 Consistency of human role with respect to human capabilities and limitations** - Operator's feedback on the roles and responsibilities - Operator's feedback on new operating methods including the CDM process	**Questionnaires and expert judgement**
EX2-OBJ-08.01-V2-VALP-OF1-003	**HP1 Consistency of human role with respect to human capabilities and limitations** - Operator's feedback on concept's benefits & feasibility	**Questionnaires and expert judgement**

Table 44: Metrics and indicators defined for EXE-08.01-V2-VALP2-002

5.2.8.2 Analysis method

The quantitative data will be recorded and logged during the exercise for a further analysis. The source for each kind of data is mentioned in **Table 44: Metrics and indicators defined for EXE-08.01-V2-VALP2-002**. The results obtained for each simulation run will be compared as described in the Scenario description to provide evidence of the operational feasibility of Dynamic Airspace Configuration and Dynamic Mobile Area concepts.

The qualitative data provided by operational experts, will be taken into account during the post processing session and will be used in the assessment and analysis of the final results according to the operational environment of the execution of the exercise.

5.2.9 Exercise Planning and management

5.2.9.1 Activities

The activities concerning EXE-08.01-V2-VALP-002 are divided into three different topics:

- Preparatory activities
- Execution activities
- Post-execution activities.

5.2.9.1.1 Preparatory activities

The main preparatory activities are described below:

- High level exercise definition (*EXE#02-Pre-01*): From the validation strategy developed for PJ.08, selection and refinement of the validation objectives, success criteria, indicators to be measured, and data collection measures;
- Scenario definition (*EXE#02-Pre-02*): This encompasses the environment selection & definition such as airspaces used, traffic preparation (including selection & adaptation of civil traffic) and the definition of military missions;
- Exercise Plan production (*EXE#02-Pre-03*): This is the production of dedicated plan for further incorporation to the PJ.08 VALP;
- Platform preparation (*EXE#02-Pre-04*): Setting up the validation platform including needed evolution(s) and data-logging checking.
- Integration of Exercise Plan in the PJ.08 Validation Plan (*EXE#02-Pre-05*): The plan is consolidated in the Solution 01 Validation Plan.
- Exercise data preparation (*EXE#02-Pre-06*): it includes airspace design for solution scenario, cloned traffic using STATFOR forecast, adaptation of traffic to POLFRA. Exercise reference simulation for scenario #01 and #02
- Platform Integration tests (*EXE#02-Pre-07*): integration of INNOVE, R-NEST, CAT, STANLY_POS and WOC ASM tools.
- Platform and tools training (*EXE#02-Pre-08*): training on the new functionalities of the tools (R-NEST, INNOVE, CAT, STANLY_POS and WOC ASM tools)
- Dry runs of the exercise (*EXE#02-Pre-09*)

5.2.9.1.2 Execution activities Exercise

The main execution activities are described below:

- Run of the exercise using R-NEST, INNOVE, CAT, STANLY_POS and WOC ASM tools.
    - Run Session 1 – Day 1 (*EXE#02-Exe-01*):
        - Execution of Solution 1 (model A) scenario #01

        - Execution of Solution 2 (model B) scenario #01
    - Run Session 2 – Day 2 (*EXE#02-Exe-02*):
        - Execution of Solution 1 (model A) scenario #02
        - Execution of Solution 2 (model B) scenario #02
- Data collection of data logs, metrics, screenshots and questionnaires (*EXE#02-Exe-03*)
- Gathering of elements for communication (taking photos and recording videos)

5.2.9.1.3 Post Exercise analysis

The main post-execution activities are reported below:

- Data analysis (EXE#02-Post-01): The purpose is to carry out the analysis of the quantitative data and the analysis of the qualitative data (questionnaires) collected during the execution phase in accordance with the validation exercise plan;
- Exercise Report production (EXE#02-Post-02): From the outputs of the analysis, report synthetize the validation results for further incorporation to the PJ.08 Validation Report;
- Integration of Exercise Report in the PJ.08 Validation Report (EXE#02-Post-03): The exercise results are consolidated in the Solution 01 Validation Report.

5.2.9.2 Roles & Responsibilities in the exercise

EUROCONTROL is the leader of EXE-08.01-V2-VALP2-002, and is responsible for the coordination between all partners involved in this exercise.

The main tasks in which **EUROCONTROL** is involved in this validation activity are the following:

- Definition of the exercise validation plan
- Elaboration of the section of Validation Plan related to the exercise
- Exercise preparation and execution
- Delivery of the R-NEST and INNOVE releases to run the exercise
- Training on the new release of the simulation tool
- Hosting and Support to the validation exercise preparation and run
- Provide NM operational expert support
- Post-processing of the outputs
- Analysis of the exercise results
- Elaboration of the section of Validation Report related to the exercise.

The main tasks in which **PANSA** is involved in this validation activity are the following:

- Support the definition of the exercise validation plan
- Review the section of Validation Plan related to the exercise
- Delivery of the CAT release with the functionalities to run the exercise
- Training on the new release of the simulation tool
- Support to the validation exercise preparation and run
- Provide ASM, FMP and AMC operational expert support
- Collection of the simulation results
- Contribute to and review the section of Validation Report related to the exercise.

The main tasks in which **DFS** is involved in this validation activity are the following:

- Support the definition of the exercise validation plan
- Review the section of Validation Plan related to the exercise
- Delivery of the STANLY_POS release with the functionalities to run the exercise
- Training on the new release of the simulation tool
- Support to the validation exercise preparation and run
- Provide AMC operational expert support
- Collection of the simulation results
- Contribute to and review the section of Validation Report related to the exercise

The main tasks in which **AIRBUS** is involved in this validation activity are the following:

- Support the definition of the exercise validation plan
- Review the section of Validation Plan related to the exercise
- Delivery of the WOC ASM release with the functionalities to run the exercise
- Training on the new release of the simulation tool
- Support to the validation exercise preparation and run
- Collection of the simulation results
- Contribute to and review the section of Validation Report related to the exercise

The roles and responsibilities of the staff involved in the exercise have been identified as follows:

- **Project leader (EUROCONTROL)**: Ensures that the exercise phases are in line with the project management plan and all major deliverables are provided in a timely manner.
- **Solution leader (EUROCONTROL)**: Responsible for ensuring coherency and consistency of the framework of the exercise with the concept as described in the OSED.
- **Exercise coordinator (EUROCONTROL)**: In charge of the preparation and planning of the exercise, including coordination with the relevant stakeholders/experts and consolidation/consistency checks of the inputs. He/she is responsible of the consolidation and production of the exercise plan and exercise report.
- **Validation expert (EUROCONTROL)**: Responsible for the definition of the exercise, integration of the exercise plan in the validation plan, analysis of results and integration of exercise report into the validation report.
- **Technical expert (EUROCONTROL, PANSA, DFS, AIRBUS)**: Responsible for the technical aspects of the exercise, ensuring workability of the platform and tools in both preparation and execution phases.
- **Operational expert (EUROCONTROL, PANSA, DFS, AIRBUS)**: Responsible for the operational definition and design of the scenarios, supporting validation expert during analysis of the results and collaborate to the production of the exercise plan and exercise report.

5.2.9.3 Time planning

EXE-08.01-V2-VALP-002 main activities will be carried out between Q3 2017 and Q1 2019.

The time planning of the validation exercise is shown in **Table 45: Detailed time planning**.

ACTIVITY	START	END
Preparatory activities	01/09/2017	31/12/2018

Execution activities	03/01/2019	18/01/2019
Post-Execution activities	21/01/2019	01/02/2019
Exercise Validation Report	21/01/2019	28/02/2019

Table 45: Detailed time planning

Activity	Month																	
	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	June 2018	July 2018	Aug 2018	Sept 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019
EXE#02-Pre-01																			
EXE#02-Pre-02																			
EXE#02-Pre-03																			
EXE#02-Pre-04																			
EXE#02-Pre-05																			
EXE#02-Pre-06																			
EXE#02-Pre-07																			
EXE#02-Pre-08																			
EXE#02-Pre-09																			
EXE#02-Exe-01																			
EXE#02-Exe-02																			
EXE#02-Post-01																			
EXE#02-Post-02																			
EXE#02-Post-03																			

Table 46: Detailed time planning for Validation Exercise EXE-08.01-V2-VALP-002

5.2.9.4 Identified Risks and mitigation actions

Some risks have been identified as susceptible to happen during the different activities that compose EXE-08.01-V2-VALP2-002.

The **Table 47** below identifies the risks for this exercise as well as their probability of occurrence, their criticality level and the proposed mitigation actions.

Risks	Impact	Probability	Mitigation Actions
Risk #01: Limitations of the validation tool on the level of significance of the results.	2-Medium	2-Medium	Involvement of all participants/actors representatives (FMP, WOC, NM) and concept people through regular meetings
Risk #02: Delay in delivery of specific developments.	3-High	3-High	Regular coordination with development teams (ad-hoc meeting if needed). Identification of potential simplification in the tools with minor impact regarding the exercises objectives.
Risk #03: Integration issues	3-High	2-Medium	Iterative integration: delivery of different versions of INNOVE providing each time new functionalities to other platforms.

Table 47: Risks and mitigation actions for Validation Exercise #02

5.3 Validation EXE-08.01-V2-VALP-003 Plan

5.3.1 Validation Exercise description and scope

EXE-08.01-V2-VALP-003 is the last exercise planned in PJ08 solution 01 to reach V2 maturity level and the first one that validates the full concept in a real time simulation platform with ATCo. It belongs to the group of three exercises (EXE-08.01-V2-VALP-006, EXE-08.01-V2-VALP-002 and EXE-08.01-V2-VALP-005) planned to evaluate the operational feasibility of DAC. Specifically, EXE-08.01-V2-VALP-003 focuses on the assessment of DAC and DMA Type I execution processes. The exercise is led by ENAIRE, supported by EUROCONTROL and will use the prototypes developed by INDRA.

The OIs that will be addressed by the exercise and its coverage limitations are shown in **Table 48**

Operational Improvement	EXE-08.01-V2-VALP-003 coverage limitations
CM-0102-B: Automated Support for Dynamic Sectorisation and Dynamic Constraint Management	INAP time horizon processes will not be modelled.
AOM-0809-A: Initial Sector Design and Configuration Unconstrained by Predetermined Boundaries	INAP time horizon processes will not be modelled
AOM-0208-B: Dynamic Mobile Areas of Type 1 and 2	Only type 1 will be considered, CDM process to set the DMA location will not be validated.

Table 48: OIs addressed by EXE08-01.03

The exercise will consist of two main activities:

- **Exercise Phase I**: several Fast Time Simulation (FTS) activities used to design the airspace and plan sector configuration based on DAC sector design criteria and DAC sector configuration algorithms.
- **Exercise Phase II**: a Real Time Simulation (RTS) aiming to assess the operational feasibility of the DAC for ATC environment by evaluating the impact on Human Performance of the actors involved (ATCo, Supervisor and LTM/EAP).

The combined assessment of the output of these activities will serve to evaluate DAC dynamicity versus ATC capability and demonstrate DAC performance improvements taking into account human factors. In addition to that, the exercise will aim also at evaluating airspace design criteria and operational procedures appropriateness for DAC implementation in the execution phase.

In order to achieve its objectives, the exercise will provide a local position tool to identify and propose airspace modifications in the framework of DAC execution processes; as well as a tool to support the implementation of DAC operational procedures during a sector configuration change. The validation scenarios will be prepared to allow assessing the readiness of DAC integration in DCB process in a free route environment.

EXE-08.01-V2-VALP-003 will use the inputs from EXE-08.01-V2-VALP-006 to identify the requirements for the CWP and initial DAC feasibility issues.

The exercise scope is defined to allow the achievement of its objectives (see detailed objectives description in section 5.3.3) and considering the status of the development of the tools to model the target environment at an acceptable level of reliability. Thus, the approach followed to model the DAC operational concept processes (see **Figure 28**) is as follows:

- Long and medium-short term DAC and DMA Type 1 processes will be modelled through Fast Time Simulation. The main output of this activity will be the airspace design and sector configuration that better adjust capacity for a given traffic demand scenario.
- Execution DAC and DMA Type 1 processes will be modelled through real time simulation implementing the DAC ATC operational procedures to the airspace design and sector configuration defined during long and medium-short term processes.
- DAC within INAP time horizon processes will not be modelled as the integration of DAC and DCB measures is not ready to be implemented in a real time simulation. This way the effectiveness of DAC processes will be assessed isolated from the execution of dDCB. This will help identifying demand and capacity imbalance problems and performance improvements that will remain after DAC implementation to be solved at INAP phase.

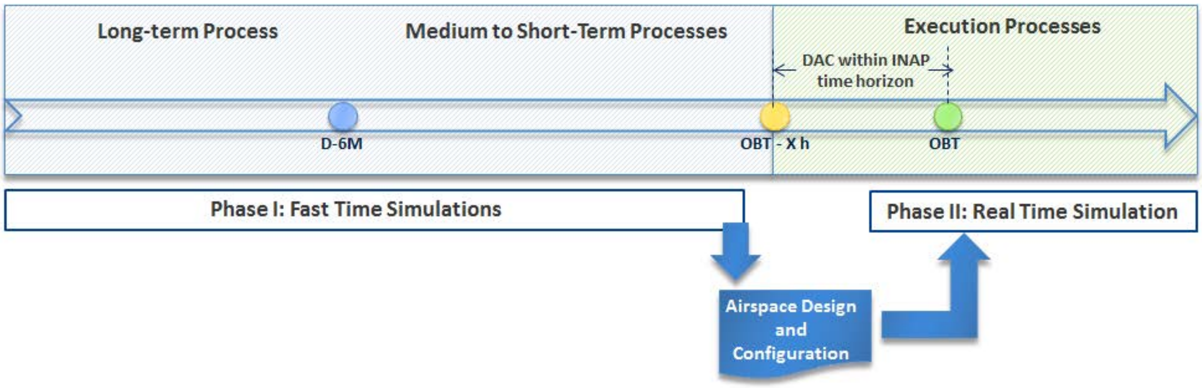

Figure 28. DAC planning term process and exercise scope

The operational concept and use cases addressed (or partially addressed) by the exercise are defined in the SESAR Solution 08.01 OSED Part I [37]:

- UC07: Impact assessment. Describes an assessment of planned DAC configuration on Local KPIs and Network Performance targets. (Limited to the assessment of local KPIs).
- UC13: ATCO situational awareness in DAC Ops environment. Describes how elements of DAC are displayed on ATCO HMI to ensure ATCo situational awareness.
- UC14: Air Traffic Control in DAC environment. Describes how an ATCo provides an Air Traffic Control service in DAC operational environment.
- UC17: INAP2 - Selection of DAC/sector configuration. Describes the decision process for the selection of adequate sector configurations using advanced support functions in short term to execution phase. (Limited to the identification and proposal of sector configuration)

Even though the modelling of INAP processes is out of the scope of the exercise, INAP use case will be considered to support the evaluation of the local position tool provided to identify and propose airspace modifications in the framework of DAC execution processes.

Hereafter, EXE-08.01-V2-VALP-003 main planned validation means and platforms are described:

- Workshops with ATCo to find out the criteria to design sectors and to establish the constraints that shall take part in the airspace design and configuration process.
- RAMS and COMETA will support the FTS to define a set of validation scenarios based on the results of the workshop.
- RNEST will support the traffic demand analysis to define a set of validation scenarios based on the DAC algorithm.
- iTEC platform and iACM prototype will be used to conduct the RTS to assess the operational feasibility of the DAC in the execution phase.
- TESEO will be used to post-process validation outputs and obtain performance indicators related to the conducted validation scenarios.

Related to the validation scenarios, EXE-08.01-V2-VALP-003 will have two reference scenarios, and four solution scenarios, as are shown in **Table 49**:

Scenario Id	EXE-08.01-V2-VALP-003 scenarios descriptions

SCN-08.01.03-VALP-0001	Reference Scenario representing current airspace design and sector configuration for a FRA high complexity traffic demand.
SCN-08.01.03-VALP-0002	Reference Scenario representing current airspace design and sector configurations including a VPA for a FRA high complexity traffic demand.
SCN-08.01.03-VALP-1001	Solution Scenario representing DAC airspace design and sector configuration based on SAB and ES for a FRA high complexity traffic demand (OSED Sector Design and Configuration Level C criteria [38]).
SCN-08.01.03-VALP-2001	Solution Scenario representing DAC airspace design and sector configuration based on AB for a FRA high complexity traffic demand (OSED Sector Design and Configuration Level B criteria [38]).
SCN-08.01.03-VALP-1002	Solution Scenario representing current airspace design and sector configurations including a DMA Type I for a FRA high complexity traffic demand.
SCN-08.01.03-VALP-2002	Solution Scenario representing DAC airspace design and sector configuration based on AB including a DMA Type I for a FRA high complexity traffic demand.

Table 49: EXE-08.01-V2-VALP-003 validation scenarios

5.3.2 Stakeholder's expectations and Benefit mechanisms addressed by the exercise

The relevant stakeholders for EXE 08-01.03 and their interest in the exercise are presented in **Table 50**.

Stakeholder	Involvement	Why it matters to stakeholder
ANSPs	Direct. ENAIRE ANSP is participating by providing its FMPs/ATCo in the Real Time Simulations and to support the preparation of the airspace design.	o Expect to significantly improve quality of service through DAC operation concept. o Expect to optimise the use of airspace capacity and reduce delays through the operational concept of dynamic airspace configuration. o Expect to improve cost efficiency through an optimum use of available human resources and residual capacity. o Expect to identify sector design criteria and constraints in harmony with DAC concept. o Expect to identify operational procedures for DAC implementation. o Expect to identify operational and technical requirements to ensure the situational awareness of ATCos during the sectorisation changes within DAC operational concept. o Expect to identify operational and technical requirements to elaborate and propose airspace modifications following DAC principles. o Expect to ensure the readiness of DAC for the integration in DCB process within a Free Route Airspace environment.

Stakeholder	Involvement	Why it matters to stakeholder
Industry	Direct. Some of the platforms/prototypes to be used in the RTS are developed and integrated by the Industry.	• Expect to generate and assess technical requirements to help mature and prove the validation concepts. • Expect to gather evidence to help them decide on continued investments and/or concept implementation • Expect to promote the benefits of the concept. • Expect to achieve the integration with other systems and tools, specifically those that facilitates the situational awareness during DAC sectorisation changes.
NM	Direct. EUROCONTROL is directly involved in the preparation of the validation scenarios (military scenarios) and through the provision of the DAC sectorisation tool (RNEST).	o Expect to assess the performance benefits of using DAC algorithms (SAGA, COBOS and ICO), which will be used to define RTS scenarios. o Expect to validate DAC operational concept within Free Route Airspace. o Expect to significantly improve predictability capacity and cost efficiency through DAC concept within Free Route Airspace. o Expect to ensure feasibility of the DMA integration within DAC execution processes and related operational procedures o Expect to ensure the readiness of DAC for the integration in DCB process within a Free Route Airspace environment.
Military Airspace Users	Military contributors to PJ08 has been involved in the definition and refinement of DMA Type I scenarios.	o Expect to ensure feasibility of the DMA integration within DAC execution processes and related operational procedures o Expect to validate the optimised location of DMA within DAC operational concept. o Flexible and effective access to airspace by relying on the responsiveness of airspace management.

Table 50: Stakeholders' expectations

Figure 29 identifies the part of the PJ08.01 solution benefit mechanisms addressed by the exercise

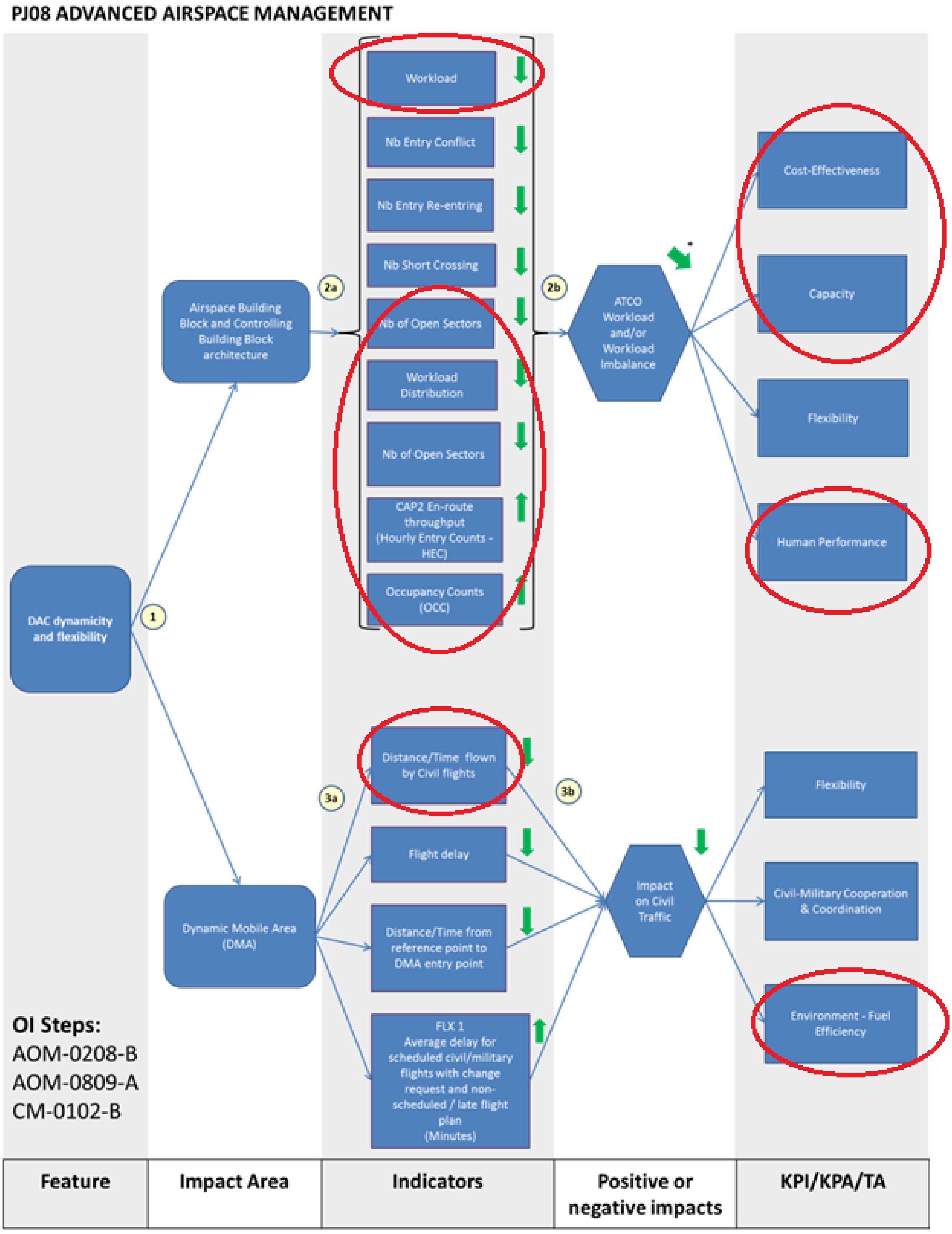

Figure 29. EXE-08.01-V2-VALP-003 Addressed BIM

5.3.3 Validation objectives

Solution Validation Objective	Solution Success criteria	Comments on the coverage of Solution Validation in Exercise 003	Exercise Validation Objective	Exercise Success criteria
OBJ-08.01-V2-VALP-PE1	**CRT-08.01-V2-VALP-PE1-001**	The exercise will evaluate the increase of the maximum available capacity and the improvement of the use of available capacity for DAC and DMA Type I taking into account different DAC dynamicity levels in nominal conditions under FRA.	**EX3-OBJ-08.01-V2-VALP-PE1-001A** To assess whether DAC and DMA Type I in FRA environment increases En-route capacity in nominal conditions.	**EX3-CRT-08.01-V2-VALP-PE1-001A** DAC airspace design in nominal conditions under FRA allows managing the higher En-route capacity.
			EX3-OBJ-08.01-V2-VALP-PE1-001B To assess whether DAC and DMA Type I in FRA environment optimises the use of available capacity in nominal conditions.	**EX3-CRT-08.01-V2-VALP-PE1-001B** DAC and DMA Type I airspace design under FRA in nominal conditions allows managing the same capacity with a better balancing of ATC workload leading to reduced demand/capacity imbalance.
	CRT-08.01-V2-VALP-PE1-002	The exercise will evaluate the increase in predictability when optimising DAC sector configuration and when locating DMA Type 1 in nominal conditions under FRA.	**EX3-OBJ-08.01-V2-VALP-PE1-002** To assess whether DAC and DMA Type I in FRA environment in nominal conditions increases predictability of the flight duration variability.	**EX3-CRT-08.01-V2-VALP-PE1-002** DAC and DMA Type I airspace design in nominal conditions under FRA decreases En-route flight duration variability.
	CRT-08.01-V2-VALP-PE1-003	The exercise will evaluate the increase in cost efficiency in nominal conditions under FRA when optimising DAC sector configuration and when locating DMA Type 1 and considering several DAC dynamicity levels.	**EX3-OBJ-08.01-V2-VALP-PE1-003** To assess whether DAC and DMA Type I in FRA environment in nominal conditions leads to an increase of cost efficiency.	**EX3-CRT-08.01-V2-VALP-PE1-003** DAC and DMA Type I airspace design and configuration in nominal conditions under FRA increases cost efficiency due to the reduction of WL per flight.
	CRT-08.01-V2-VALP-PE1-004	The exercise will evaluate the effects in safety in nominal conditions under FRA when optimising DAC sector configuration and when locating DMA Type considering several DAC dynamicity levels.	**EX3-OBJ-08.01-V2-VALP-PE1-004** To assess whether DAC and DMA Type I maintains the current level of safety in nominal conditions under FRA.	**EX3-CRT-08.01-V2-VALP-PE1-004A** DAC and DMA Type I airspace design and configuration in nominal conditions under FRA maintains the current level of safety according to the experience of the ATCo during the validation exercise.
				EX3-CRT-08.01-V2-VALP-PE1-004B DAC and DMA Type I airspace design and configuration in nominal conditions under FRA do not increase the number of moderate and severe overloads.
				EX3-CRT-08.01-V2-VALP-PE1-004C Separation minima infringements in En-Route sectors does not appear in the DAC and DMA Type I solution scenarios.

Solution Validation Objective	Solution Success criteria	Comments on the coverage of Solution Validation in Exercise 003	Exercise Validation Objective	Exercise Success criteria
				EX3-CRT-08.01-V2-VALP-PE1-004D The number of Planning conflicts does not increase in the analysed DMA Type 1 solution scenarios.
				EX3-CRT-08.01-V2-VALP-PE1-004E The number of BT incursions into ARES/DMA (crew/aircraft induced and ATC induced) does not increase in the analysed DMA Type 1 solution scenarios.
				EX3-CRT-08.01-V2-VALP-PE1-004F The number of ATC induced tactical conflicts created by own unit/sector (encompassing BT/MT-BT/MT in civil/military mixed operations) does not increase in the analysed DMA Type 1 solution scenarios.
	CRT-08.01-V2-VALP-PE1-005	The exercise will evaluate DAC and DMA Type 1 reduction of flight duration in nominal conditions under FRA considering several DAC dynamicity levels.	**EX3-OBJ-08.01-V2-VALP-PE1-005** To assess if the DAC and DMA Type I have any positive impact on environment in nominal conditions under FRA due to a reduction in the average flight duration.	**EX3-CRT-08.01-V2-VALP-PE1-005** DAC and DMA Type reduces the average flight duration in nominal conditions under FRA.

Table 51: Validation Objectives addressed in Validation Exercise 3. Performance Benefits Objectives

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Solution Validation Objective	Solution Success criteria	Comments on the coverage of Solution Validation in Exercise 003	Exercise Validation Objective	Exercise Success criteria
OBJ-08.01-V2-VALP-TF1	**CRT-08.01-V2-VALP-TF1-001**	The exercise will analyse the readiness of the proposed tools: to monitor and update airspace configuration and to solve complexity issues to apply the optimum airspace configuration.	**EX3-OBJ-08.01-V2-VALP-TF1-001A** Assess technical feasibility of DAC to monitor, identify and propose airspace modifications following the DAC principles in the execution phase.	**EX3-CRT-08.01-V2-VALP-TF1-001A** LTM/EAP tool allow monitoring, identifying and proposing DAC optimal configuration according to DAC execution phase processes and procedures.
				EX3-CRT-08.01-V2-VALP-TF1-001B LTM/EAP local tool requirements to identify and propose DAC optimal configuration according to DAC execution phase processes and procedures have been identified.
			EX3-OBJ-08.01-V2-VALP-TF1-001B Assess technical feasibility of DAC ATC operational procedures in the execution phase.	**EX3-CRT-08.01-V2-VALP-TF1-001C** Supervisor tool allow choosing and disseminating DAC optimal configuration according to DAC execution phase procedures.
				EX3-CRT-08.01-V2-VALP-TF1-001D ATCo supporting tools allow assessing, accepting and implementing DAC optimal configuration according to DAC execution phase procedures.
			EX3-OBJ-08.01-V2-VALP-TF1-001C Assess technical feasibility of DMA Type 1 operational procedures in the execution phase.	**EX3-CRT-08.01-V2-VALP-TF1-001E** ATCo supporting tools allow assessing, accepting and implementing DMA Type 1.
	CRT-08.01-V2-VALP-TF1-002	The exercise will analyse the usability of the proposed automation support **in the execution phase** for the decision-making process assessing and comparing different airspace configurations based on complexity.	**EX3-OBJ-08.01-V2-VALP-TF1-002** Assess usability of the LTM/EAP local position automated support for the decision-making process assessing and comparing different airspace configurations based on complexity in the execution phases following the DAC principles.	**EX3-CRT-08.01-V2-VALP-TF1-002A** The LTM/EAP local position tool proposes several DAC configurations based on complexity following his/her request/query.
				EX3-CRT-08.01-V2-VALP-TF1-002B The LTM/EAP local position tool provides in the execution phase, complexity assessment that facilitates the selection of the DAC configuration following the DAC principles.
				EX3-CRT-08.01-V2-VALP-TF1-002C The LTM/EAP local tool provides complexity information that is reliable enough to identify and propose airspace modifications in the execution phase following the DAC principles.
				EX3-CRT-08.01-V2-VALP-TF1-002D The LTM/EAP local position allows the completion of the complexity assessment according to the timeframe restrictions to propose airspace modifications in the execution phase following the DAC principles.
	CRT-08.01-V2-VALP-TF1-003.	The exercise analyses the usability of automated support to monitor in the execution phase the implemented solutions.	**EX3-OBJ-08.01-V2-VALP-TF1-003** Assess usability of the local position to monitor automatically the implemented solutions based on dynamic airspace management in the execution phase.	**EX3-CRT-08.01-V2-VALP-TF1-003** The LTM/EAP local position tool provides useful, timely and reliable information to monitor the implemented airspace modifications in the execution phase.

Table 52: Validation Objectives addressed in Validation Exercise 3. Technical Feasibility Objectives

Solution Validation Objective	Solution Success criteria	Comments on the coverage of Solution Validation in Exercise 003	Exercise Validation Objective	Exercise Success criteria
OBJ-08.01-V2-VALP-OF1	**CRT-08.01-V2-VALP-OF1-001**	The exercise will assess the operational feasibility of DAC and DMA Type I execution processes	**EX3-OBJ-08.01-V2-VALP-OF1-001A** Provide evidence of the LTM/EAP/Supervisor/ATCo human capability to successfully apply DAC ATC operational procedures maintaining an acceptable level of workload.	**EX3-CRT-08.01-V2-VALP-OF1-001A** LTM/EAP/Supervisor/ATCo are able to successfully apply operational procedures keeping acceptable level of workload.
				EX3-CRT-08.01-V2-VALP-OF1-001B In case of a DCB imbalance situation, the LTM/EAP is able to identify and select a DAC configuration that may solve it and meets operational needs.
				EX3-CRT-08.01-V2-VALP-OF1-001C Supervisor is able to assess and disseminate DAC configuration taking into account operational needs and according to DAC ATC procedures.
				EX3-CRT-08.01-V2-VALP-OF1-001D ATCo are able to assess, accept and implement DAC optimal configuration according to DAC ATC procedures
				EX3-OBJ-08.01-V2-VALP-OF1-001E The ATCo are able to carry out DAC operational procedures during the implementation of DMA Type I.
			EX3-OBJ-08.01-V2-VALP-OF1-001B Assess the effect of DAC dynamicity level on the human capability to successfully accomplish tasks and meet job requirements	**EX3-CRT-08.01-V2-VALP-OF1-001F** The effect of the application of several DAC dynamicity levels in workload and situational awareness have been assessed and sector design criteria and restrictions applicable to DAC execution timeframe identified accordingly.
	CRT-08.01-V2-VALP-OF1-002		**EX3-OBJ-08.01-V2-VALP-OF1-002A** The roles of the implied actors in the DAC execution phase process are clearly defined	**EX3-CRT-08.01-V2-VALP-OF1-002A** All the actors know and are able to carry out their functions
			EX3-OBJ-08.01-V2-VALP-OF1-002B Assess role consistency of DAC actors, providing evidence that the LTM/EAP/Supervisor/ATCo are able to exchange the necessary information to accomplish their tasks.	**EX3-CRT-08.01-V2-VALP-OF1-002B** DAC operational procedures are successfully applied allowing the required information exchange between actors.
			EX3-OBJ-08.01-V2-VALP-OF1-002C Develops operational procedures to ensure the human capability to successfully accomplish tasks and job requirements	**EX3-OBJ-08.01-V2-VALP-OF1-002C** Operational procedures applicable to DAC execution timeframe are identified to ensure acceptable workload level and situational awareness.
	CRT-08.01-V2-VALP-OF1-003		**EX3-OBJ-08.01-V2-VALP-OF1-003A** Assess the confidence of the user in the DAC tools	**EX3-CRT-08.01-V2-VALP-OF1-003A** Actors involved trust in the tools provided to support the implementation of the DAC ATC decision-making.

Solution Validation Objective	Solution Success criteria	Comments on the coverage of Solution Validation in Exercise 003	Exercise Validation Objective	Exercise Success criteria
			EX3-OBJ-08.01-V2-VALP-OF1-003B Assess User interface acceptability related to timeliness of system responses.	**EX3-CRT-08.01-V2-VALP-OF1-003B** Actors involved consider that system responses during the configuration changes were acceptable, and the information was provided at the right moment
			EX3-OBJ-08.01-V2-VALP-OF1-003C Assess User-machine interaction acceptability.	**EX3-CRT-08.01-V2-VALP-OF1-003C** Actors involved consider that the user-machine interaction is good to allow access to the right information with and acceptable effort to not interfere the provision of the ATC service

Table 53: Validation Objectives addressed in Validation Exercise 3. Operational Feasibility Objectives

Solution Validation Objective	Solution Success criteria	Comments on the coverage of Solution Validation in Exercise 003	Exercise Validation Objective	Exercise Success criteria
OBJ-08.01-V2-VALP-CO1	**CRT-08.01-V2-VALP-CO1-001**	The validation will be performed in FRA environment according to PJ06 FRA definition.	**EX3-OBJ-08.01-V2-VALP-CO1-001** Assess the operational feasibility as well as the benefits of DAC integrated in a free route operational environment	Same as **OBJ-08.01-V2-VALP-OF1-XXX** and **OBJ-08.01-V2-VALP-PE1-XXX**
	CRT-08.01-V2-VALP-CO1-002	The exercise will initiate the development of DAC and DCB relationships	**EX3-OBJ-08.01-V2-VALP-CO1-002A** Develop relationships between DAC and DCB concepts in terms of performance needs to be addressed through DAC and DCB integration at INAP timeframe.	**EX3-CRT-08.01-V2-VALP-CO1-002A** Performance improvement targets at INAP timeframe are identified and recommendations for DAC-DCB integration at this timeframe were issued.
			EX3-OBJ-08.01-V2-VALP-CO1-002B Develop relationships between dynamic airspace configuration concept and DCB by identifying and characterising remaining demand and capacity imbalance problems to be solved at INAP planning phase.	**EX3-OBJ-08.01-V2-VALP-CO1-002B** The imbalances that could not be solved though DAC has been identified and characterised **EX3-OBJ-08.01-V2-VALP-CO1-002C** Deviations of the DAC sector configuration proposed by the EAP/LTM in the execution phase in comparison with the ones proposed before INAP timeframe have been identified and the causes of these deviations identified.
	CRT-08.01-V2-VALP-CO1-003	The validation will be performed in FRA environment. Only DMA Type 1 will be addressed.	**EX3-OBJ-08.01-V2-VALP-CO1-003** Develops relationships between DMA type 1 allocation management concept with Free Routing concept	**EX3-CRT-08.01-V2-VALP-CO1-003** DMA Type 1 design principles facilitate free routing operations from ATCo perspective

Table 54: Validation Objectives addressed in Validation Exercise 3. Compatibility Objectives

5.3.4 Validation scenarios

EXE-08.01-V2-VALP-003 validation scenarios aims to reflect the operational scenarios and use cases concerning DAC execution processes described in PJ08 OSED (See[37]). The sub-operating environment applicable to the validation scenarios is En-Route, with a high complexity layout. The geographical area chosen to comply with these requirements is the one bounded by the contour of the sectors LECMCJU, LECMCJL, LECMTER and LECMZGZ from Madrid ACC, that is LECMANA sectors (see **Figure 30**).

The traffic sample validated will be the same as the one used in P06.01 exercises [43] to ensure full alignment with SESAR Free Route Concept of operations. This traffic has the following characteristics:

- FRA over Madrid ACC and Barcelona ACC over FL245 (see Figure 30)
- Free Route in high complexity environment
- 2017 processed traffic (an increase of 21% according to STATFOR traffic forecast for 2022)

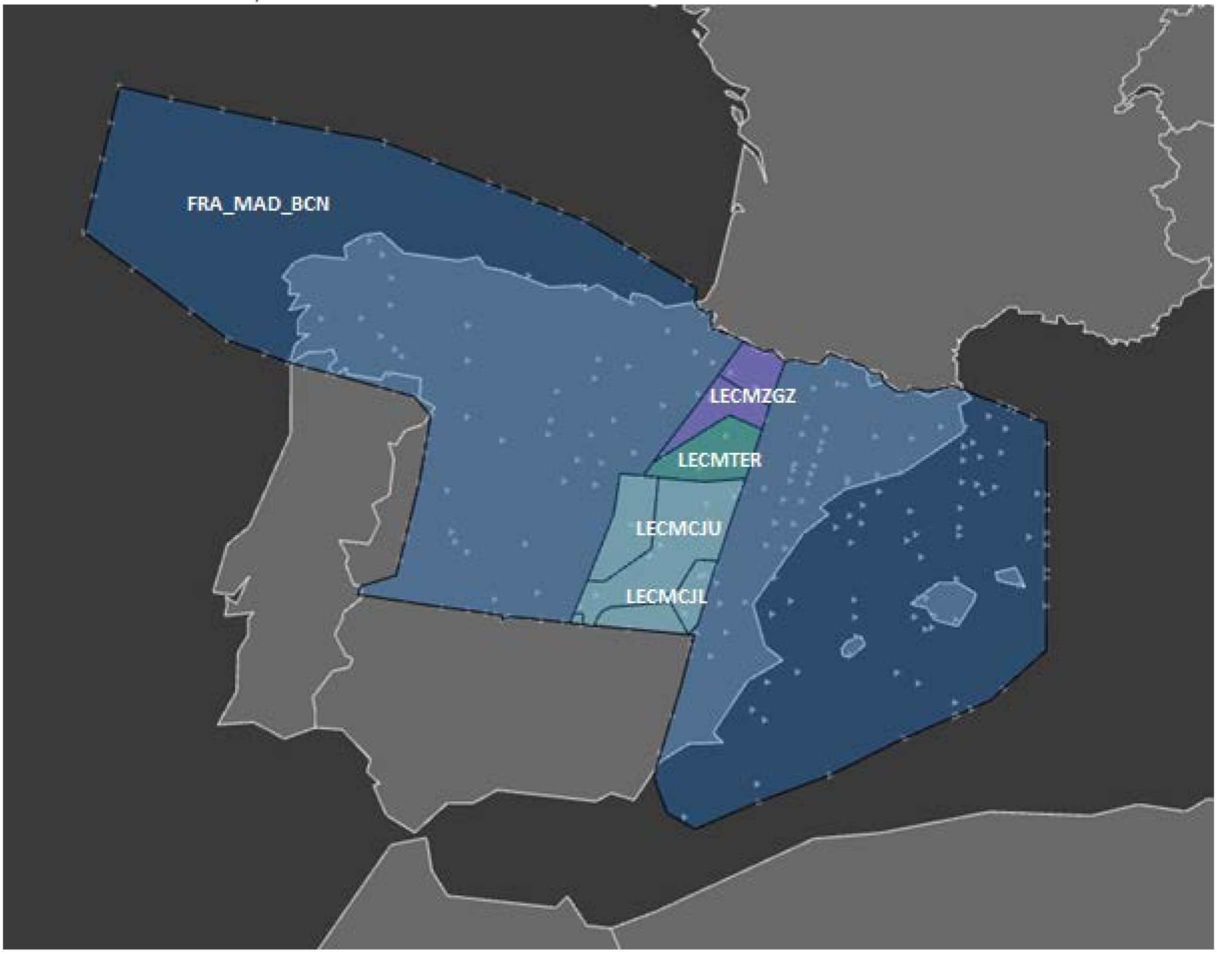

Figure 30. FRA defined for EXE-08.01-V2-VALP-003.

Several Reference and Solution Scenarios will be developed to service this traffic over the selected geographical area representing the operating environment before and after the integration of the DAC concept elements to be validated (DAC and DMA Type I). **Table 55** lists these scenarios. **Table 56** describes the main characteristics of each scenario.

Scenario Id	EXE-08.01-V2-VALP-003 scenarios descriptions
SCN-08.01.03-VALP-0001	Reference Scenario representing current airspace design and sector configuration for a FRA high complexity traffic demand.
SCN-08.01.03-VALP-0002	Reference Scenario representing current airspace design and sector configurations including a VPA for a FRA high complexity traffic demand.
SCN-08.01.03-VALP-1001	Solution Scenario representing DAC airspace design and sector configuration based on SAB and ES for a FRA high complexity traffic demand (OSED Sector Design and Configuration Level C criteria [38]).
SCN-08.01.03-VALP-2001	Solution Scenario representing DAC airspace design and sector configuration based on AB for a FRA high complexity traffic demand (OSED Sector Design and Configuration Level B criteria [38]).
SCN-08.01.03-VALP-1002	Solution Scenario representing current airspace design and sector configurations including a DMA Type I for a FRA high complexity traffic demand.
SCN-08.01.03-VALP-2002	Solution Scenario representing DAC airspace design and sector configuration based on AB including a DMA Type I for a FRA high complexity traffic demand.

Table 55. EXE-08.01-V2-VALP-003 Scenarios.

		SCN-08.01.03-VALP-0001	SCN-08.01.03-VALP-0002
Airspace	**Airspace**	FRA from FL245	
	Airspace design	Current airspace design	Current airspace design
	Airspace configuration	Sectorisation providing maximum capacity	Sectorisation providing maximum capacity
	Military Area	-	LED104 (portion allocated inside the three sectors)
Traffic	**Traffic Forecast**	2022	2022

		SCN-08.01.03-VALP-1001	SCN-08.01.03-VALP-2001	SCN-08.01.03-VALP-1002	SCN-08.01.03-VALP-2002
Airspace	**Airspace**	FRA from FL245			
	Airspace design	ES and SABs defined based on expert judgement	ABs defined based on SAGA, COBOS	Current airspace design	ABs defined based on SAGA, COBOS
	Airspace configuration	DAC sectorisation obtained through Fast time simulation + WL assessment	DAC sectorisation obtained through ICO algorithm	Current sectorisation	DAC sectorisation obtained through ICO algorithm
	Tool	RAMS&COMETA	RNEST	N/A	RNEST
	Military Area	-	-	DMA Type 1	DMA Type 1
Traffic	**Traffic Forecast**	2022	2022	2022	2022

Table 56. EXE-08.01-V2-VALP-003 Scenarios definition.

5.3.4.1 Reference Scenario SCN-08.01.03-VALP-0001

The Reference Scenario SCN-08.01.03-VALP-0001 represents the scenario against which the solution scenarios representing DAC sector configuration (Solution Scenarios SCN-08.01.03-VALP-1001 and SCN-08.01.03-VALP-1002) will be compared. The main characteristics of SCN-08.01.03-VALP-0001 are summarised in **Table 57**.

Feature		SCN-08.01.03-VALP-0001
Airspace	Airspace	FRA from FL245
	Airspace design	Current airspace design
	Airspace configuration	Sectorisation providing maximum capacity
	Military Area	-
Traffic	Traffic Forecast	2022

Table 57. Reference Scenario SCN-08.01.03-VALP-0001 main characteristics.

5.3.4.1.1 Airspace information.

The validation exercise will be done in Madrid ACC, which is a high complexity [41]. Madrid ACC is divided in Madrid Route 1 (North) and Madrid Route 2 (South). From Madrid Route 2 (South), the sectors LECMCJU, LECMCJL, LECMTER and LECMZGZ have been selected to validate the concept. It is important to bear in mind that FRA is defined from FL245 and therefore, the scenario starts from FL245. **Table 58** collects their relevant data: declared capacity and the lower/upper levels.

SECTOR	VOLUME	CAPACITY	OBSERVATIONS
LECMCJL 245/325	CJL	42	Elementary Sector
LECMCJL 325/460	CJU	43	Elementary Sector
LECMTER 245/460	TER	37	Elementary Sector
LECMZGZ 245/460	ZGZ	40	Elementary Sector

Table 58. SCN-08.01.03-VALP-0001 Analysed sectors.

All the sectors of analysis are elementary sectors, thus cannot be split in smaller sectors according to current airspace design. However, they can be merged to generate collapsed sectors as defined in **Table 59**.

SECTOR	VOLUME	CAPACITY	OBSERVATIONS
LECMCJI 245/325	CJL, CJU	37	Collapsed Sector
LECMTZI 325/460	TER, ZGZ	37	Collapsed Sector

Table 59. SCN-08.01.03-VALP-0001 Collapsed sectors.

There are several predefined airspace configurations for Madrid Route 2 (South). According to them, four airspace configuration could be implemented in the geographical area of study (see **Table 60**).

MADRID ROUTE 2 CONFIGURATION ID	SECTORS			
3B, 4A, 5A1, 5A2, 5D, 6D1, 6D2	LECMCJI	LECMTZI		
5B, 6B1, 6B2, 6F, 7C1, 7C2	LECMCJL	LECMCJU	LECMTZI	
5C, 6A1, 6A2, 6E, 7B1,7B2	LECMCJI	LECMTER	LECMZGZ	
6C, 7A1, 7A2, 7D, 8A1, 8A2	LECMCJL	LECMCJU	LECMTER	LECMZGZ

Table 60. SCN-08.01.03-VALP-0001 Sector Configurations

In order to provide maximum available capacity to serve the selected traffic, SCN-08.01.03-VALP-0001 will implement the configuration using the maximum number of sectors in the area of study (the one composed by the four elementary sectors presented).

5.3.4.1.2 Traffic information.

The traffic sample used for Reference Scenario SCN-08.01.03-VALP-0001 will be the STATFOR Forecast 2022 traffic sample referred to the busiest summer day, corresponding to 30 July 2017. This traffic sample has been transformed to FRA.

5.3.4.2 Solution Scenario SCN-08.01.03-VALP-1001

The main characteristics of Solution Scenario SCN-08.01.03-VALP-1001 are summarised in **Table 61**.

Feature		Solution Scenario SCN-08.01.03-VALP-1001
Airspace	Airspace	FRA from FL245
	Airspace design	ES and SABs defined based on expert judgement
	Airspace configuration	Fast time simulation + WL assessment
	Tool	RAMS + COMETA
	Military Area	-
Traffic	Traffic Forecast	2022

Table 61. Solution Scenario SCN-08.01.03-VALP-1001 main characteristics.

5.3.4.2.1 Airspace information.

The sectorisation and the airspace design of Solution Scenario SCN-08.01.03-VALP-1001 will be based on Elementary Sector (ES), Sharable Airspace Block (SAB) and Vertical Sharable Airspace Module (VSAMS) defined for the airspace that is currently occupied by LECMCJU, LECMCJL, LECMTER and LECMZGZ sectors.

5.3.4.2.2 Traffic information.

The traffic sample used for Solution Scenario SCN-08.01.03-VALP-1001 will be the STATFOR Forecast 2022 traffic sample, which is increased by 21%, referred to the busiest summer day, corresponding to 30 July 2017. This traffic sample has been transformed to FRA.

5.3.4.2.3 Airspace design and configuration process.

Airspace will be designed by expert judgement in an ATCo workshop according to the design of DAC operational concept, particularly Elementary Sector (ES), Sharable Airspace Block (SAB) and Vertical Sharable Airspace Module (VSAMS).

Once these airspace volumes are defined, all the possible configurations will be analysed by a Fast Time Simulation in RAMS. The outcome of this process is a list of control events that will be the input to COMETA. The latest tool calculates the workload of every sector at each of the possible configurations.

In order to compare which configuration is the one that optimises the airspace, some relative metrics will be used based on total workload in the scenario, average sector WL, standard deviation WL, and workload variability.

A workload-capacity analysis will be carried out to determine if the workload of a sector in a scenario is manageable for ATCo based on Stevens Power's law.

The law links the sensation changes to the stimulus intensity and is expressed in **Equation 1**,

$$\Psi = k \cdot I^{a}$$

Equation 1. Stevens Power's law (1957)

Ψ **is the magnitude of the sensation;** ***I*** **is the intensities of the physical stimulus;** ***K*** **is a constant and** ***a*** **is an exponent that depends on the type of stimulus.**

This law can be generalised to this case study in order to propose a mental workload function that predicts the capacity values. Therefore, from Stevens' law, **Equation 2** can be deducted,

$$MWL_{supported\ by\ one\ controller} = k \cdot Capacity_{entries}^{a}$$

Equation 2. Stevens Power's law deduction for capacity analysis.

where ***MWL*** is a constant value for all the sectors and can be deducted from the current sectorisation. This value will be used as an absolute metric, so that if the workload of any sector in a scenario exceeds the threshold defined from this metric, the configuration will be discarded.

5.3.4.3 Solution Scenario SCN-08.01.03-VALP-2001

The main characteristics of Solution Scenario SCN-08.01.03-VALP-2001 are summarised in Table 62.

Feature		Solution Scenario SCN-08.01.03-VALP-2001
Airspace	**Airspace**	FRA from FL245
	Airspace design	ABs defined based on SAGA, COBOS
	Airspace configuration	ICO algorithm
	Tool	RNEST
	Military Area	-
Traffic	**Traffic Forecast**	2022

Table 62. Solution Scenario SCN-08.01.03-VALP-2001 main characteristics.

5.3.4.3.1 Airspace information.

Solution Scenario SCN-08.01.03-VALP-2001 will be obtained from the optimisation process made by RNEST to define the ABs that optimises the airspace that currently is occupied by LECMCJU, LECMCJL, LECMTER and LECMZGZ sectors.

5.3.4.3.2 Traffic information.

The traffic sample used for Solution Scenario SCN-08.01.03-VALP-2001 will be the STATFOR Forecast 2022 traffic sample, which is increased by 21%, referred to the busiest summer day, corresponding to 30 July 2017. This traffic sample has been transformed to FRA.

5.3.4.3.3 Airspace design and configuration process.

As an input to the airspace design, that is to say to SAGA and ICO algorithm, some parameters need to be defined. These inputs can be divided into five groups:

- Airspace to design.
- Number of ABs to create and definition of the vertical constraints.
- Workload associated with control events i.e. conflict resolution, crossing time, ...
- Optimisation criteria.

- Period of time when the airspace is optimised.

Once the airspace design is done, the capacity of these new ABs needs to be defined. That value will be used as an input to ICO algorithm which proposes the optimal airspace configuration based on the ABs airspace design. Stevens Power's law (which is described in section 5.3.4.2.3) will be used to determine the capacity of the new airspace design.

5.3.4.4 Reference Scenario SCN-08.01.03-VALP-0002

The reference scenario SCN-08.01.03-VALP-0002 represents the current way of operations for execution of military missions – activation of airspace reservation structure and modular design ARES for the whole period of the exercise execution time.

The reference scenario SCN-08.01.03-VALP-0002 will provide data for comparison for rerouted civil traffic and for the MTs – the ratio of calculated flight time to ARES vs. total flight time. For example, the figure below shows re-routed civil traffic during a VPA activation.

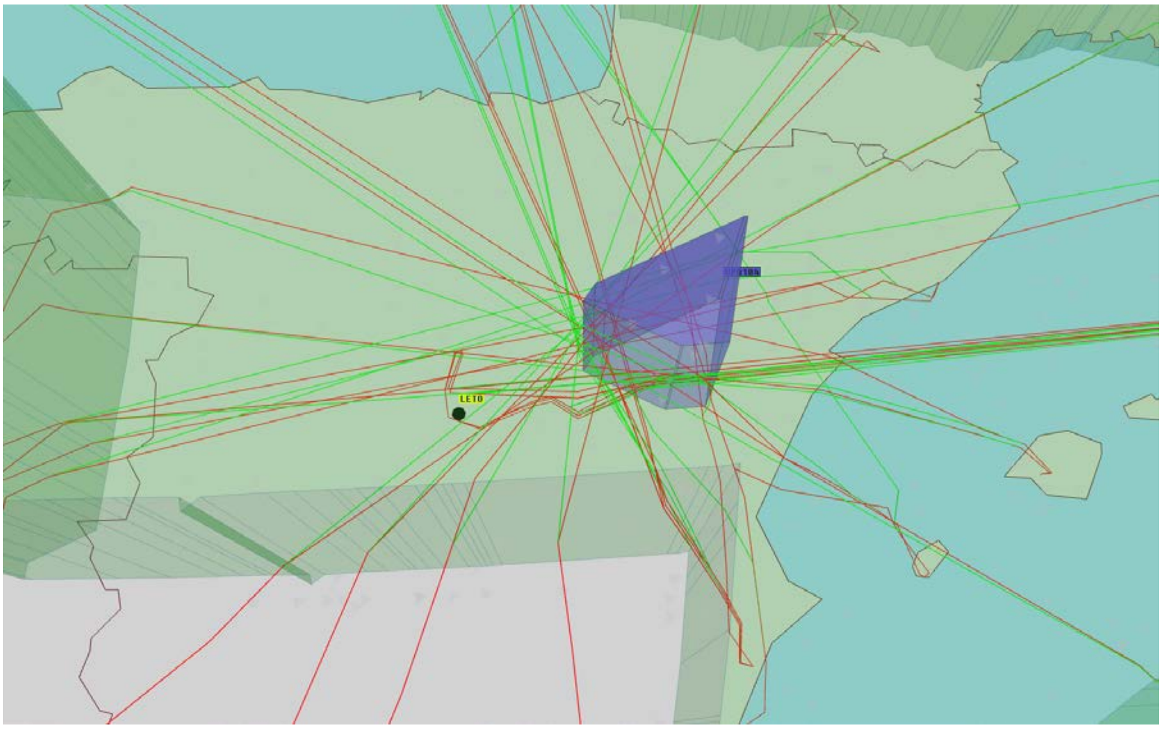

Figure 31: Example SCN-08.01.03-VALP-0002_VPA activation

5.3.4.4.1 Airspace information.

Sector configurations are as defined for Reference Scenario SCN-08.01.03-VALP-0001, in addition the reference scenario SCN-08.01.03-VALP-0002 contains a VPA type activated ARES, based on the portion of LED104 allocated inside the three sectors of Madrid En-Route 2 (South) (See **Figure 32**).

Figure 32: ARES design within the Reference Scenario SCN-08.01.03-VALP-0002

5.3.4.4.2 Traffic information.

The traffic sample will be the STATFOR Forecast 2022 traffic sample, which is increased by 21%, referred to the busiest summer day, corresponding to 30 July 2017. This traffic sample has been transformed to FRA.

Military Scenario represents execution of three missions in the VPA104 within the timeframe 10:00 to 13:00 hrs. The VPA104 is activated for the whole period. All military missions are executed from MADRID/TORREJON (LETO) AFB. The planning of military missions and the allocation of VPA104 is shown in **Table 63** below.

EXE-08.01-V2-VALP-003_RS2_VPA	Aircraft type and number	Mission	ARES: **VPA104** FL: **245 – 460**	a/p
Mission 1	1xA400	Functional Check Flight (FCF)	10:00 – 11:00	LETO
Mission 2	4xEF18	Combat Air Patrol (CAP)	11:00 – 12:00	LETO
Mission 3	2xEF2000	Air Reconnaissance (RECCE)	12:00 – 13:00	LETO

Table 63: Reference Scenario SCN-08.01.03-VALP-0002 missions and VPA104 planning

5.3.4.5 Solution Scenario SCN-08.01.03-VALP-1002

The outcome of the solution scenario SCN-08.01.03-VALP-1002 – rerouted traffic due to DMA activations will be used to compare results with Reference scenario SCN-08.01.03-VALP-0002. This will provide data to assess the effect of DMA use in comparison to VPA (DMA concept application outcome).

5.3.4.5.1 Airspace information.

Sector configurations are as defined for Reference Scenario SCN-08.01.03-VALP-0001 and SCN-08.01.03-VALP-0002. In addition, this solution scenario will present consequent activations of three DMAs along the same simulation time window as the period of VPA activation in the Reference Scenario SCN-08.01.03-VALP-0002.

The design of DMAs will be based on complying with the military requirements as defined by flexible parameters by using a simple rectangular shape.

DMA104A	DMA104B	DMA104C

Figure 33: DMAs flexible parameters

In order to limit influencing factors and to obtain unique results for comparison, the shape of DMAs will not be altered in the solution scenarios. The size of the shape (2D area) will not be changed, whereas the volume will be different (due to different FL band), according to the mission needs. (It must be noted that VPA104 would be activated in the full FL range 245-460). Also for achieving consistent results, the 2D size of DMA is comparable to the one of the VPA and even bigger. This is clearly depicted on **Figure 34**. In this way, any potential positive or beneficial results for BTs rerouting cannot be attributed to a smaller 2D size of DMAs.

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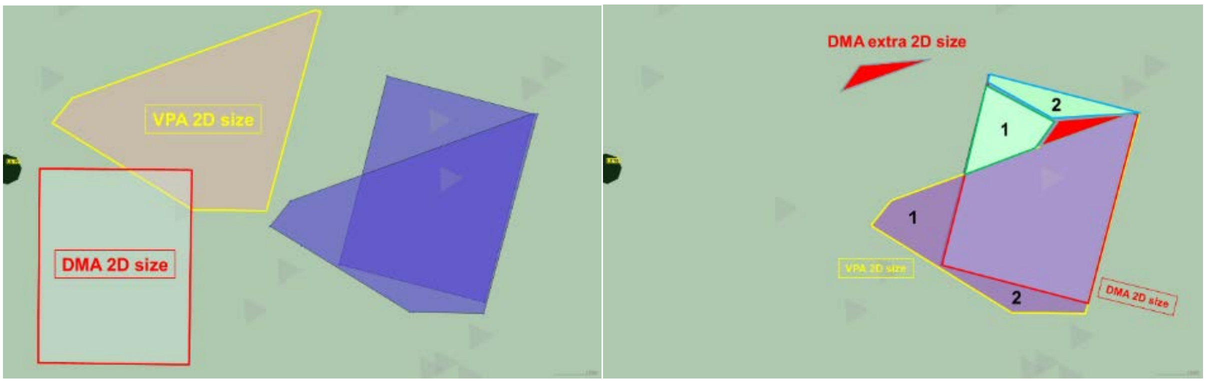

Figure 34: DMA design and 2D comparison with VPA size

Although one of the advantages of DMA concept is ability to adjust the DMA size and volume according to the mission needs, thus optimising the airspace usage, as explained above the 2D size of DMAs is not changed in the solution scenarios. Nevertheless, the results are expected to show significant differences in affected traffic when safety buffer is applied, which is a one more hint that deviations in the ARES design 1 – 3 NM may affect significantly BTs parameters.

Although DAC concept gives freedom in the way of safety buffer application, for simplification of exercise scenarios it is assumed that the safety buffer is entirely included into the DMAs volumes.

Figure 35 shows the location of the DMA within LECMANA sectors as well as the FRA area defined for the exercise.

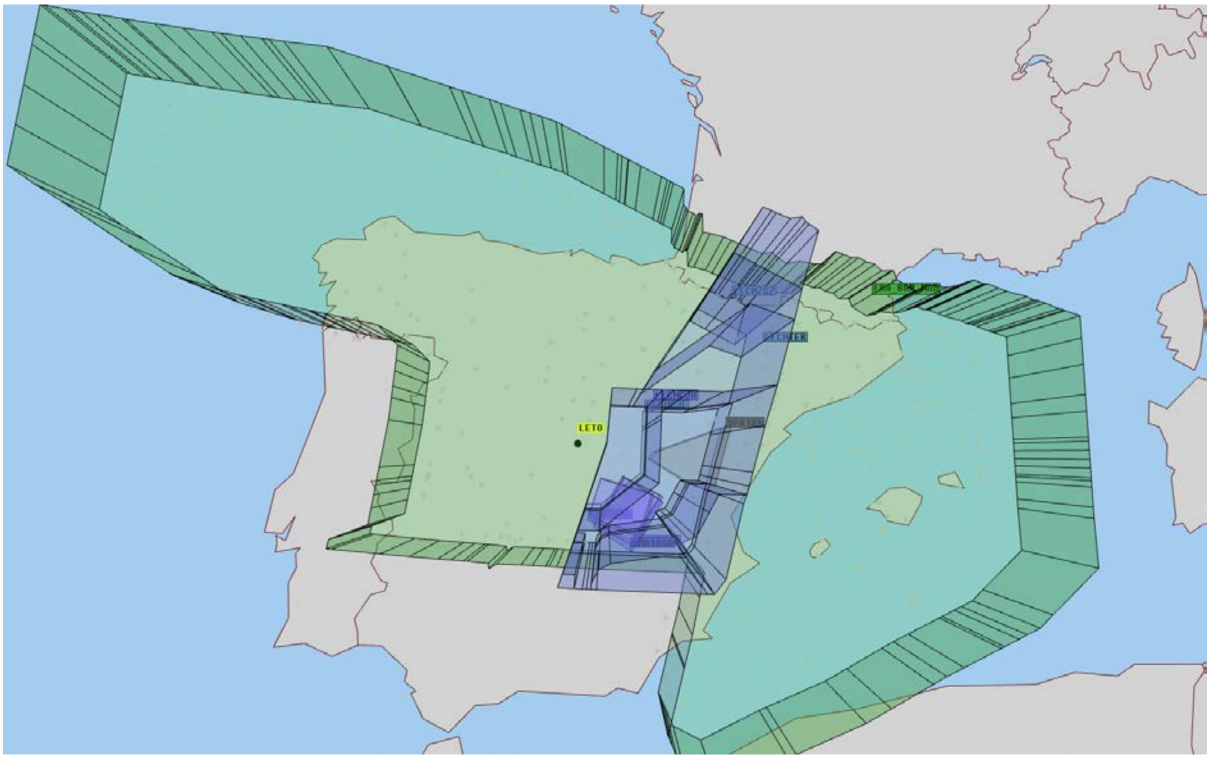

Figure 35: SCN-08.01.03-VALP-1002 Airspace

Three DMAs – DMA104A, DMA104B and DMA104C (Fig36) are identified to address the needs of the same three Military missions as in the reference scenario SCN-08.01.03-VALP-0002. They will be positioned in the optimal geographical locations within the airspace of LECMANA sectors, using the RNEST automated function and in accordance with the defined by WOC flexible parameters as presented in **Figure 33**.

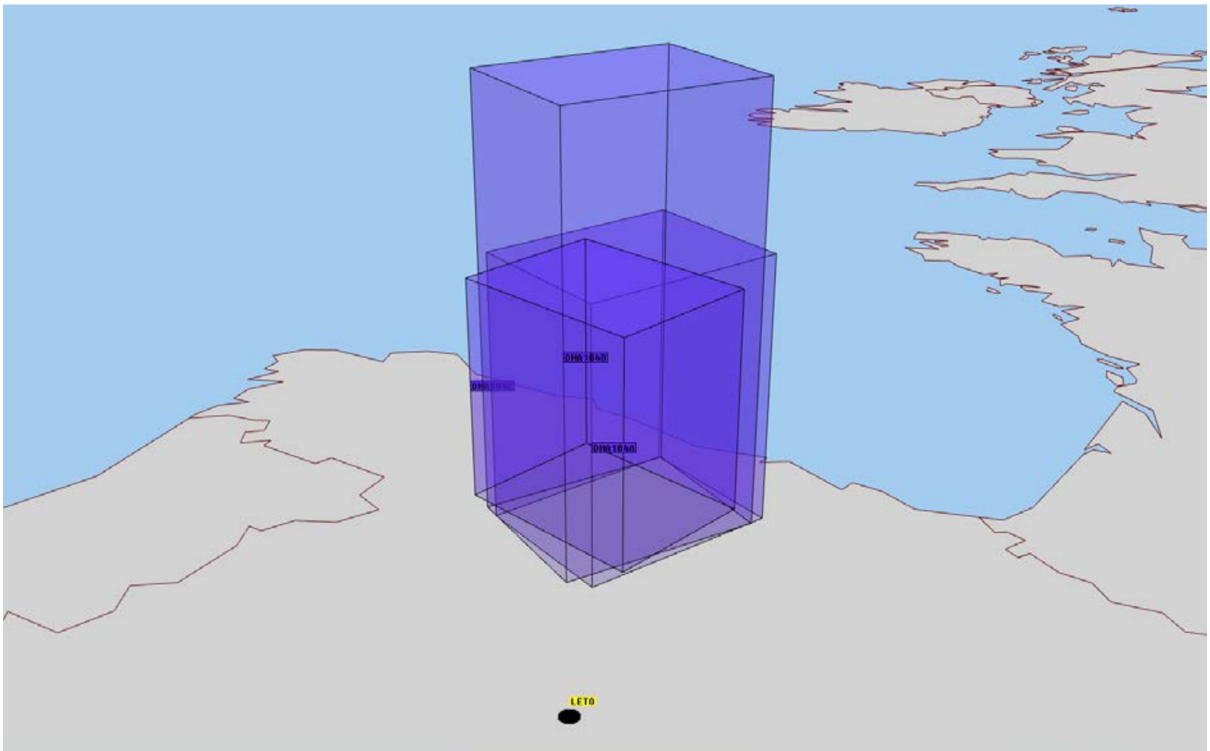

Figure 36: SCN-08.01.03-VALP-1002 DMAs

5.3.4.5.2 Traffic information.

The traffic sample will be the STATFOR Forecast 2022 traffic sample, which is increased by 21%, referred to the busiest summer day, corresponding to 30 July 2017. This traffic sample has been transformed to FRA.

In this scenario the time window for execution of missions is the same 10:00 to 13:00 hrs, the mission are executed according to the planning, therefore the DMAs are activated according to each mission ("timely de-conflicted"). Mission planning with corresponding DMAs is presented in **Table 64**.

EXE-08.01-V2-VALP-003_SS2_DMA	Aircraft type	Mission	DMA FL DMA activation	a/p
Mission 1	A400	Functional Check Flight (FCF)	DMA104A FL 245 - 380 10:00 – 11:00	LETO
Mission 2	4xEF18	Combat Air Patrol (CAP)	DMA104B FL 245 – 460 11:00 – 12:00	LETO

Mission 3	2xEF2000	Air Reconnaissance (RECCE)	DMA104C FL 245 - 360 12:00 – 13:00	LETO

Table 64: SCN-08.01.03-VALP-1002 missions and DMAs consequent activation planning

5.3.4.5.3 Airspace design and configuration process.

The sequence of airspace design and configuration process is as follows:

- design DMAs based on the set of flexible parameters;
- run optimisation of DMA positioning;
- activate DMAs;
- get BTs of rerouted traffic.

5.3.4.6 Solution Scenario SCN-08.01.03-VALP-2002

This scenario is similar to SCN-08.01.03-VALP-1002 regarding the military missions and DMA activations but based on a DAC sectorisation (the one defined in the solution scenario SCN-08.01.03-VALP-2001).

The Solution Scenario will provide data for assessment of the cumulative effect of DMA concept application and DAC sectorisation on ACC activities.

5.3.5 Exercise Assumptions

Assumptions made in EXE 08-01.03 are presented into Table 65.

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
ASS-08-01.03-001	Non-nominal conditions	Traffic characteristics	Non-nominal situation due to weather conditions are out of the scope of EXE 08-01.03.	Exercise characteristics	En-route	CAP, HP	This VALP	N/A	EXE 08-01.03	Medium
ASS-08-01.03-002	Realistic traffic sample	Traffic characteristics	The traffic simulated in the exercise is based on STATFOR forecasts for the year 2022 and could be considered as representative of this date.	Realism of the exercise	En-route	CAP, HP	This VALP	N/A	EXE 08-01.03	Medium
ASS-08-01.03-003	Traffic sample	Traffic characteristics	The Free Route traffic sample to be tested in this exercise has been previously validated in EXE 06-01	Alignment with PJ06 concept	En-route	CAP, HP	This VALP	N/A	EXE 08-01.03	Medium
ASS-08-01.03-005	Airspace analysed	Airspace characteristics	The airspace analysed is representative enough to test DAC operational concept	Exercise characteristics	En-route	All	This VALP	N/A	EXE 08-01.03	Medium
ASS-08-01.03-006	Training	Human performance	All operational staff involved in the exercise have the appropriate training to conduct the simulation	Exercise Performance	En-route	HP	This VALP	N/A	EXE 08-01.03	High
ASS-08-01.03-007	DMA location	Airspace characteristics	DMA location is optimised according to military criteria validated in EXE 08-01.04	Alignment with PJ08 concept	En-route	CAP; HP	This VALP	N/A	EXE 08-01.03	Medium
ASS-08-01.03-008	Safety Buffer	Airspace characteristics	For simplification of exercise scenarios it is assumed that the safety buffer is entirely included into the DMAs volumes	Simplification	En-rourte	CAP; SAF	This VALP	N/A	EXE 08-01.03	Low

Table 65: Validation Exercise Assumptions

5.3.6 Limitations and impact on the Level of Significance

The potential limitations of EXE 08-01.03 could come from the following aspects:

- The validation is done in FRA environment whereas the geographical area analysed is currently ATS route structure. Although the FRA used is based on SESAR2020 validated FRA scenario (PJ06), there might be FRA operational issues that might hinder potential DAC operational improvements.
- PJ06 used FRA traffic sample represents a scenario of 2022 while P08.01 target scenario is 2023. Slight traffic increase could be expected from 2022 to 2023 that will not be considered.
- The limitation of the number of CWP and ATCo available for the simulation constrains the number of sectorisations and configurations that can be tested. Two one-hour traffic samples and a limited number of sectors will be evaluated, thus limiting the expected representativeness of the performance results, which will need to be extrapolated to other areas or traffic situations.
- DAC within INAP time horizon processes will not be modelled as the integration of DAC and DCB measures is not ready to be implemented in a real time simulation.
- The exercise will not consider non-nominal conditions due to bad weather.

5.3.7 Validation Exercise Platform / Tool and Validation Technique

5.3.7.1 Validation Exercise Platform / Tool characteristics

5.3.7.1.1 iTEC platform and iACM prototype

EXE-08.01-V2-VALP-003 RTS will be executed in iTEC platform connected to iACM protoype, both developed by INDRA. iTEC is a platform for Air Traffic Management, including Flight Data Processing and Controller Working positions with advanced tools, such as Conflict Detection and Resolution. iACM is a prototype to support the monitoring and assessment of DCB imbalances based on entry counts, occupancy and complexity as well as elaborate DCB solutions to address them. To do so, iACM receives the FP from iTEC and the complexity from COMETA tool (see **Figure 37** and section 5.3.7.1.2).

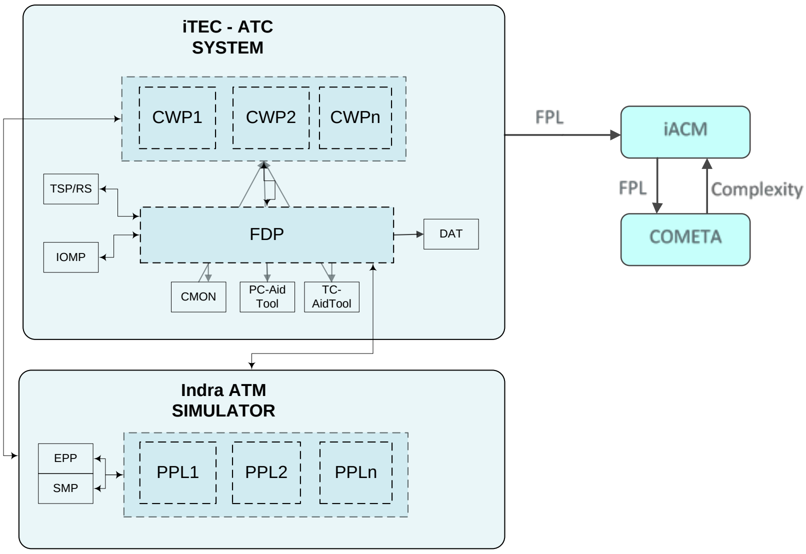

Figure 37: Simplified diagram of the connections between iTEC Platform, iACM prototype and COMETA tool

The main functions of the iTEC V&V platform used in this exercise are also represented in **Figure 37**:

- Flight Data Processor (FDP) is a function responsible for processing and managing flight plans. It provides real-time flight information and other processed air traffic management (ATM) data (e.g. surveillance, meteorological, etc.) to other functions, provides correlation and flight path monitoring, enables automated co-ordination between internal sectors and with adjacent air traffic control centres;
- Controller Working Position (CWP) encompasses all the capabilities related to data presentation and user interaction with the air traffic controller;
- Conflict Detection Tools:
    - (PC-Aid Tool) Computes 3D risks (e.g. En-Route Risk, Entry Risk, Exit Risk, etc.) based on the planned trajectories of the flight plans for those controllers whose managed airspace is crossed by the involved flights;
    - (TC-Aid Tool) Computes potential conflicts between aircraft pairs based on the tactical trajectory resulting from controller clearances. Controllers are warned if aircraft are predicted to violate the separation criteria with respect to any other aircraft.
- Integrated Operational Management Function (IOMP) is the position for the operational supervision of the ATC system;
- Technical Supervision Position (TSP); Recording System (RS); Data Analysis Tool (DAT).
- iTEC SIMULATOR components, which are those sub-systems that are necessary to perform the RTS:
    - Pseudo-Pilot Working position (PPLs) where Pseudo pilots will manage the flights during the RTS;
    - SMP (Session Manager Position) and Exercise Preparation Position (EPP) to be used to prepare the simulation scenarios and to launch the RTS exercises.

In order to support ATCo and Supervisor ATC operational procedures, an DAC ATC supporting tool developed by INDRA will be integrated in the CWP. This tool aims to provide situational awareness during the sectorisation changes by showing information about the sectorisation change in advance such as, newly assumed/released area, flights under ATCo responsibility at the moment of the change, new transfer conditions, etc.

The lay-out of the iTEC platform at CRIDA premises (Figure 38) to allow the execution of this exercise is as follows:

- Up to 4 CWPs for the measured sectors (additional CWP for feeder sectors);
- 6 pseudo-pilots (PPs) (in a different room);
- The rest of positions are shown in the figure below.

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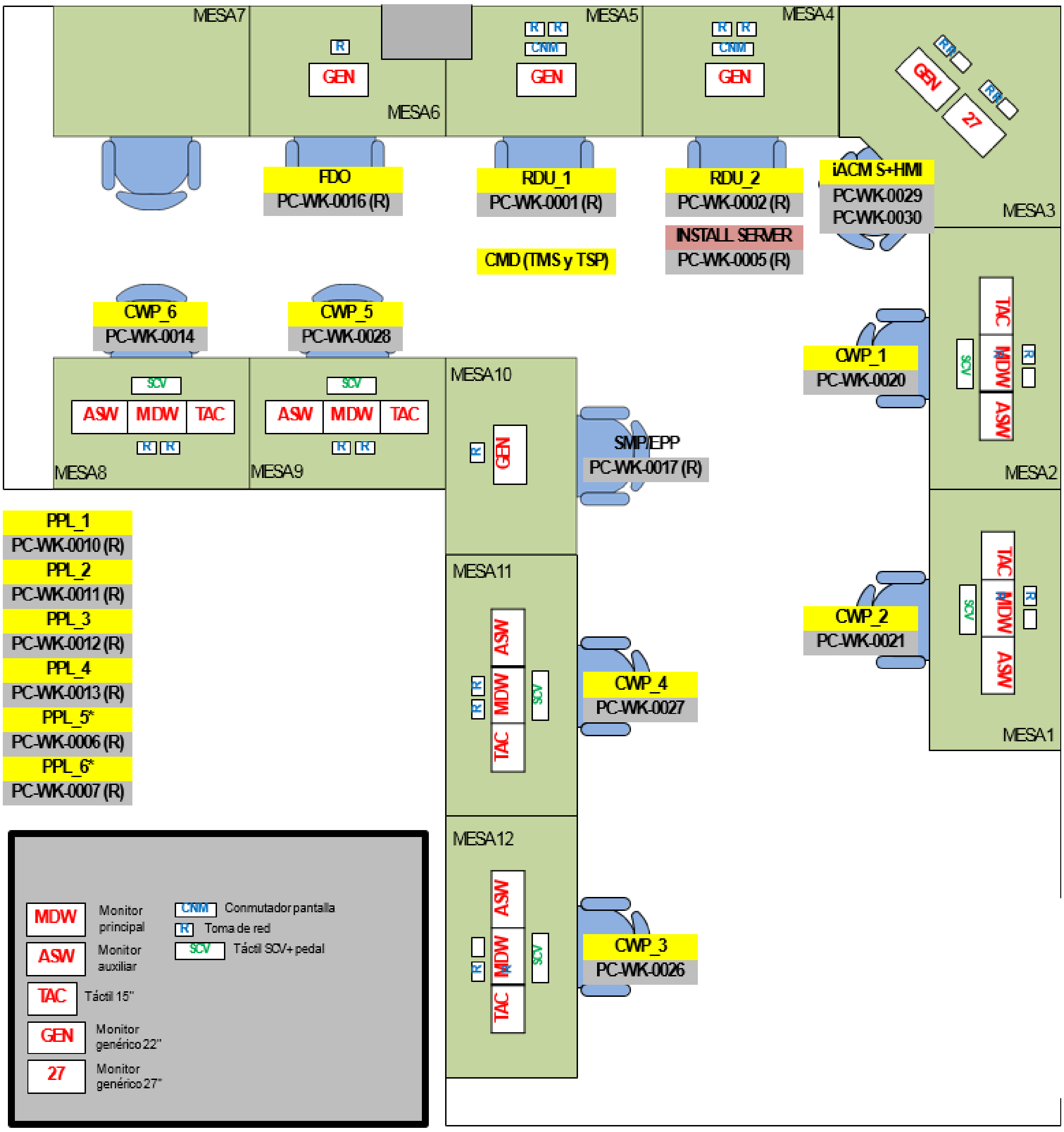


Figure 38. EXE 08-01.03 Layout.

5.3.7.1.2 RAMS and COMETA

EXE-08.01-V2-VALP-003 FTS will use RAMS and COMETA. For the purpose of EXE-08.01-V2-VALP-003, COMETA receives flight information from the RAMS simulation outputs and uses them to compute estimated WL per planned sector.

RAMS: It is a comprehensive high-fidelity gate-to-gate ATM/Airport fast-time simulation tool applied in the design, analysis, and planning of ATM systems that simulates traffic from a macro-to-micro level (gate-to-gate movements). A single scenario can contain as many flights, sectors, and airports as the user needs, from a local to global level, to provide insights into the ATM system being studied.

COMETA (Cognitive Model for ATCo Workload Assessment): It is a stand-alone tool that estimates the Air Traffic Controller cognitive workload by using a computerised model built from empirical research and psychological theories of human cognitive processes. It is supported by a predefined operational concept which establish a set of control events and tasks that allow the modelling of the air traffic controller behaviour, and consequently, the air traffic controller mental workload. Its main functionalities are the following:

- Air Traffic Controller workload assessment: the ATCo mental workload is calculated for a specific sector and time period.
- Provision of traffic complexity indicators, such as: occupancy counts, entry counts, flights contributing to workload, and aircraft potential crossings.

5.3.7.1.3 RNEST

RNEST will support the traffic demand analysis to define validation scenarios based on the DAC algorithm.

R-NEST (Research Network Strategic Tool): R-NEST is a model-based simulation tool, sharing the same base as the EUROCONTROL NEST tool. R-NEST is EUROCONTROL integrated validation tool combining advanced dynamic ATFCM capabilities with powerful airspace design and capacity planning analysis functionalities. It offers powerful scenario-based modelling engine to simulate ATM network operations, detect and observe various types of delays, identify and dynamically resolve demand vs capacity imbalances over the network, use concepts such as STAM, create dynamic airspace sectorisation using new algorithms and measure performance improvements of new ATM concepts on a network level. The ICO analyser is part of R-NEST and allows optimising the ACC configuration opening scheme to balance controller usage with overloads using a customizable optimisation strategy. The ICO analyser displays the opening scheme and corresponding controller usage and overload indicators before and after applying the optimisation strategy.

5.3.7.1.4 TESEO

TESEO (Tactical Exercise Simulator and Evaluator for DCB Operations): It is the simulation environment of PERSEO, ENAIRE’s performance monitoring and assessment system. TESEO is a modular system based on a Service Oriented Architecture that draws on the information available in the ATM Simulator in place (either Fast-Time or Real-Time, in a similar way that the operational PERSEO uses official Spanish Air Navigation System data) which is merged to construct an event database. This database is exploited by different services that provide, amongst others, the capability to measure the performance of the ANS in most KPAs (based on standard and custom developed KPIs), as well as workload, adding innovative linkage between KPIs that enables cross analysis. Using a combination of historical and real-time/fast-time data, TESEO is able to provide estimations of all the KPI dataset, as well as providing with some basis ASM capabilities. TESEO uses ‘connectors’ to obtain and exchange information with other systems (in the operational environment these connectors include the SACTA system, while in the simulation environment the connector are available for all the existing simulators in the CRIDA-ENAIRE IBP, including the present and future Spanish ATC Platforms, as well as the future Network Manager using B2B services).

For the purposes of this validation exercise, TESEO will be used for data and indicators analysis.

5.3.7.2 Validation Exercise Platform / Tool characteristics

V&V Platform Name		iTEC platform and iACM prototype
A.1.1	It is a new developed V&V platform?	Yes
A.1.2	If yes, which are the reasons supporting the development of a new platform?	The former platform developed for SESAR 1 was out-of-date and a new development compatible with the NM B2B services and the future ENAIRE ATM system (iTEC) was required
A.2	It is the first time to be used for a SESAR validation exercise	No, it has been used in SESAR EXE-09.02.03 exercise
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	N/A.
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	N/A
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	Supporting tools increase situational awareness during DAC sectorisation changes and supports DAC ATC operational procedures iACM allows complexity assessment of the implemented sectorisation LTM Monitors and Detects Demand & Capacity Imbalances and capacity management measures that could solve them (i.e. sectorisation changes)
D	Which validation methods can be used on the new V&V Platform?	Real Time, Shadow Mode, Live Trial
V&V Platform Name		**RAMS**
A.1.1	It is a new developed V&V platform?	NO: this tool has already been used for Validation Exercises within SESAR 1 Framework (e.g. 04.07.01 – VP 003 Validation Exercise)
A.1.2	If yes, which are the reasons supporting the development of a new platform?	N/A.

A.2	It is the first time to be used for a SESAR validation exercise	NO
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	N/A
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	N/A
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	N/A
D	Which validation methods can be used on the new V&V Platform?	N/A
V&V Platform Name		**COMETA**
A.1.1	It is a new developed V&V platform?	No: this tool has already been used for Validation Exercises within SESAR 1 Framework (e.g. 04.07.01 – VP 003 Validation Exercise)
A.1.2	If yes, which are the reasons supporting the development of a new platform?	N/A
A.2	It is the first time to be used for a SESAR validation exercise	NO
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	N/A
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	N/A
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	N/A
D	Which validation methods can be used on the new V&V Platform?	N/A
V&V Platform Name		**RNEST**
A.1.1	It is a new developed V&V platform?	NO.

A.1.2	If yes, which are the reasons supporting the development of a new platform?	N/A
A.2	It is the first time to be used for a SESAR validation exercise	NO. It has been already used during SESAR I validation sessions and by exercises VP-08.01-01, VP-08.01.02 and VP-08.01-04.
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	N/A
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	N/A
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	N/A
D	Which validation methods can be used on the new V&V Platform?	N/A
V&V Platform Name		**TESEO**
A.1.1	It is a new developed V&V platform?	NO: this tool has already been used for Validation Exercises within SESAR 1 Framework (e.g. 04.07.01 – VP 003 Validation Exercise)
A.1.2	If yes, which are the reasons supporting the development of a new platform?	N/A
A.2	It is the first time to be used for a SESAR validation exercise	NO
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	N/A
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	N/A
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	N/A
D	Which validation methods can be used on the new V&V Platform?	N/A

Table 66: Validation Exercise Platform / Tool characteristics

5.3.7.3 Architectural view: mapping Validation Infrastructure and SUTs onto EATMA

V&V Platform Name		iTEC platform and iACM prototype
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	o ATFCM o SWIM Yellow Profile o Voice o En-Route/Approach ATC
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	o Performance Measurements and monitoring (linked to ASM and ATFCM systems) o Demand and Capacity Balancing (linked to ATFCM system) o Traffic Demand Management (linked to ATFCM system) o G/G Voice Communication (linked to Voice system) o Controller Human Machine Interaction Management ER/APP o Local Air Traffic Complexity Management o Flight Planning - Lifecycle Management - Data Distribution
V&V Platform Name		**COMETA/RAMS/TESEO/RNEST**
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	• En-Route / Approach ATC • ASM
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	• Local Air Traffic Complexity Management • Demand and Capacity Balancing

Table 67: Validation Exercise Platform / Tool mapping onto EATMA

5.3.7.4 Validation Exercise Technique

The main goal of the EXE-08.01-V2-VALP-003 is to evaluate the effect of DAC sector design and sector configuration process in the ATC procedures, specifically in the Human Performance of the actors involved (ATCo, Supervisor and LTM/EAP). To do so, a DAC Sector Configuration planning shall be executed in high fidelity ATC environment and the operation of the ATC actors involved analysed.

RTS technique has been chosen as it puts the human (i.e. ATCo, Supervisor and LTM/EAP) in the centre of the simulation. This allows assessing the effect of DAC environment in the human through the collection of performance data obtained from the records of the validation platform; use of other complementary tools to assess workload; or the evaluation of the concept taken from the experience of the operational staff involved in the simulation.

The RTS will be performed in an ATM platform that includes all the environment used by the ATCo to provide ATS, iTEC. In addition, iTEC platform is platform is complemented by:

- a local position tool to identify and propose airspace modifications in the framework of DAC execution processes (iACM);
- a tool to support the implementation of DAC operational procedures during a sector configuration change.
- a tool to evaluate ATCo Complexity. (COMETA).

The combination of these platform and tools allows the emulation of DAC execution processes environment as described in PJ08 OSED UC13: ATCO situational awareness in DAC Ops environment and UC14: Air Traffic Control in DAC environment (see[37]).

Although the validation is focused in the execution phase, DAC sector design and configuration in the long, medium and short term planning phases shall be modelled to determine the DAC sector configuration that would result from them and, therefore the DAC sector configuration that will be executed in the RTS. To do so, FTS based on RAMS, RNEST and COMETA will be used. The FTS will allow analysing traffic demand and proposing -based on different DAC optimisation criteria- the most optimal DAC sector configuration design that will be validated in the execution phase. In the case or the military scenarios, the FTS will serve also to determine the optimal location of the DMA Type 1.

The exercise execution will last seven days. Each day, three one hour duration RTS executions will be run. During each execution, two sectors will be selected to be measured whereas the rest will be managed by feeder sectors. In total six ATCo will participate, one executive and one planner controller per measured sectors and one executive controller per feeder. During the execution, four traffic samples (TS1, TS2, TS3 and TS4) will be used for the validation scenarios identified.

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7: Visitors' Day
SCN-08.01.03-VALP-0001 - TS1	SCN-08.01.03-VALP-0002 - TS2	SCN-08.01.03-VALP-1001 - TS3	SCN-08.01.03-VALP-0001 - TS1	SCN-08.01.03-VALP-2001 - TS1	SCN-08.01.03-VALP-1001 - TS1	Introduction to the visitors
SCN-08.01.03-VALP-0002 - TS2	SCN-08.01.03-VALP-2001 - TS3	SCN-08.01.03-VALP-1002 - TS2	SCN-08.01.03-VALP-2002 - TS2	SCN-08.01.03-VALP-0001 - TS3	SCN-08.01.03-VALP-0001 - TS3	SCN-08.01.03-VALP-1002 - TS4
SCN-08.01.03-VALP-1001 - TS3	SCN-08.01.03-VALP-2001 - TS1	SCN-08.01.03-VALP-1001 - TS1	SCN-08.01.03-VALP-2001 - TS3	SCN-08.01.03-VALP-2002 - TS2	Final Debriefing	SCN-08.01.03-VALP-2002 - TS4
Debriefing	Debriefing	Debriefing	Debriefing	Debriefing		Exercise Closure

Table 68: RTS execution plan

5.3.8 Analysis Specification

5.3.8.1 Data collection methods

EXE-08.01-V2-VALP-003 will provide two different types of data: quantitative and qualitative. Qualitative data refers to subjective measurements collected from the actors evaluation of concept under validation by using different methods:

- Individual questionnaires: specific questionnaires will be developed to collect expert judgement about different aspects of concept feasibility or compatibility with other concepts.
- Debriefing sessions: after each run, all participants will discuss the difficulties encountered during the exercise run. The output of this sessions will serve to identify needs for improvements in the concept (e.g. information needs to maintain situational awareness, gaps in the definition of the operational procedures, needs for improvement in the technical support, etc.).

Quantitative results are understood as objective measurements obtained from the records of the validation tools. Quantitative data will be used to provide evidence of the performance benefits expected for the validated scenarios. Main sources of quantitative during the exercise are:

- The FTS simulators (RAMS/RNEST) outputs, which will provide the figures related to traffic movements necessary to estimate the Capacity and Fuel efficiency indicators for the predicted traffic demand and airspace design proposal;The RTS simulator (iTEC) records, which will provide the figures related to the traffic that was actually serviced by the ATCo. It will serve to compute the Capacity, predictability, cost efficiency, safety and fuel efficiency indicators for the executed scenario and implemented airspace design; ISA tool for WL self-assessment, the controllers will periodically report the ATCO workload in a scale from 1 to 5; SMI Eye Tracking Glasses, which monitors physiological factors of the ocular activity linked to workload and measurement of ATCo attention. This measure will be used as complementary to other data collection methods to evaluate WL; The iACM outputs, which will provide the records of the airspace volumes and configuration in use as well as the evaluation of their complexity; COMETA tool, which will provide the evaluation of ATCo workload based on the estimation of the cognitive complexity. COMETA can be fed from the FTS data or from the RTS data (it is integrated within the iACM); TESEO tool, which will be used for postprocessing iTEC records to obtain several KPIs (e.g. number of Number of separation minima infringements in ENR sectors).

Table 69provides an overview of the data collection methods that will be used to obtain the relevant data for analysis from the two exercise phases.

Exercise Validation Objective	Metric/KPI	Data collection method /Tool Phase I	Data collection method /Tool Phase II
EX3-OBJ-08.01-V2-VALP-PE1-001A	**CAP2** En-route throughput, in challenging airspace, per unit time	RNEST RAMS	
EX3-OBJ-08.01-V2-VALP-PE1-001B	**HP1.2** Workload	COMETA	ISA tool for WL self-assessment SMI Eye Tracking Glasses COMETA
EX3-OBJ-08.01-V2-VALP-PE1-002	**PRD6** Standard Deviation of the distribution of actual En-route durations vs. planned En-route durations	RNEST RAMS	iTEC Records/TESEO
EX3-OBJ-08.01-V2-VALP-PE1-003	**HP1.2** Workload	COMETA	ISA tool for WL self-assessment SMI Eye Tracking Glasses
EX3-OBJ-08.01-V2-VALP-PE1-004	**SAF1** Total number of fatal accidents and incidents		iTEC Records/TESEO
	HP1.2 Workload		ISA tool for WL selfassessment SMI Eye Tracking Glasses

Exercise Validation Objective	Metric/KPI	Data collection method /Tool Phase I	Data collection method /Tool Phase II
	SAC01c Number of separation minima infringements in ENR sectors		iTEC Records/TESEO
	SAC01b The number of Planning conflicts	RAMS/ RNEST	
	SAC03 number of BT incursions into ARES/DMA		iTEC records
	SAC04a the number of ATC induced tactical conflicts created by own unit/sector (encompassing BT/MT-BT/MT)		Questionnaire (e.g. I struggled to detect conflicts [1-5])
EX3-OBJ-08.01-V2-VALP-PE1-005	**FEFF1** Actual Average fuel burn per flight **FEFF3** Reduction in average flight duration	RNEST	iTEC Records/TESEO
EX3-OBJ-08.01-V2-VALP-TF1-001A **EX3-OBJ-08.01-V2-VALP-TF1-001B** **EX3-OBJ-08.01-V2-VALP-TF1-001C**	Suitability of LTM/EAP support tool. Suitability of Supervisor support tool. Suitability of ATCo support tool.		Questionnaire Debriefing sessions
EX3-OBJ-08.01-V2-VALP-TF1-002 **EX3-OBJ-08.01-V2-VALP-TF1-003**	Suitability of LTM/EAP automated support based on complexity. Suitability of Supervisor automated support based on complexity	Tool verification	Questionnaire Debriefing sessions
EX3-OBJ-08.01-V2-VALP-OF1-001A	**HP3.3** Communication burden and Situational Awareness		Questionnaire Debriefing sessions ISA tool for WL selfassessment SMI Eye Tracking Glasses Questionnaire Debriefing sessions
EX3-OBJ-08.01-V2-VALP-OF1-001B	**HP1.2** Workload		
EX3-OBJ-08.01-V2-VALP-OF1-002A **EX3-OBJ-08.01-V2-VALP-OF1-002B** **EX3-OBJ-08.01-V2-VALP-OF1-002C**	**HP1.1** Task descriptions		Questionnaire Debriefing sessions
EX3-OBJ-08.01-V2-VALP-OF1-003A	**HP2.1** Trust in Automation		
EX3-OBJ-08.01-V2-VALP-OF1-003B	**HP2 .2** Timeliness of system responses		
EX3-OBJ-08.01-V2-VALP-OF1-003C	**HP2 .3** User interface Usability		
EX3-OBJ-08.01-V2-VALP-CO1-001	Same as OBJ-08.01-V2-VALP-OF1-XXX and OBJ-08.01-V2-VALP-PE1-XXX	Same as OBJ-08.01-V2-VALP-OF1-XXX and OBJ-08.01-V2-VALP-PE1-XXX	Same as OBJ-08.01-V2-VALP-OF1-XXX and OBJ-08.01-V2-VALP-PE1-XXX
EX3-OBJ-08.01-V2-VALP-CO1-002A	Same as OBJ-08.01-V2-VALP-OF1-XXX and OBJ-08.01-V2-VALP-PE1-XXX		
EX3-OBJ-08.01-V2-VALP-CO1-002B	**HP1.2** Workload	COMETA	COMETA ISA tool for WL self-assessment
	CAP2 En-route throughput, in challenging airspace, per unit time		iTEC Records/TESEO
EX3-OBJ-08.01-V2-VALP-CO1-003			Questionnaire Debriefing sessions

Table 69: Metrics and Indicators defined for Validation Exercise EXE-08.01-V2-VALP-003

5.3.8.2 Analysis method

Standard statistic (mean values, standard deviation values, etc.) will be applied for the analysis of each success criterion and its corresponding indicators when the data available allows it (e.g. in the case of the performance data obtained from the FTS).

In the case of the RTS outputs, quantitative and qualitative results will be combined to assess validation results:

- Questionnaires allow obtaining a wide variety of views from a number of people who might have different but equally relevant perspectives. Used in combination with debriefings they ensure to collect the feedback of all the controllers involved avoiding producing final results biased. Questionnaires will be prepared to obtain the perception of the actors in a structured way, debriefings will serve to analyse the rationale behind the given feedback.

- On the other hand, quantitative data will be obtained from system data recorded during each session. Post-analysis tools will serve to compute the different indicators based on flight tracks and flight plans.

For the assessment of each success criterion, the indicators to be assessed as well as the validation scenarios in which they shall be evaluated have been identified. It must be noted that, depending on the nature of the indicator, the analysis can be done in the phase I or II of the exercise.

5.3.9 Exercise Planning and management

5.3.9.1 Activities

The activities concerning EXE-08.01-V2-VALP-003 are divided into three different topics:

- Preparatory activities

- Execution Activities

- Post-execution activities

5.3.9.1.1.1 Preparatory activities

The main preparatory activities are described below:

- Definition of the exercise: including details such as selection of functionalities available in the prototypes, validation scenarios, validation objectives, indicators to be measured, and data collection measures
- Traffic preparation: selection of the traffic sample to be used and conversion of trajectories to make them flying free route operations.
- Preparation of RAMS scenarios. The airspace design and sector configuration of the solution scenario SCN-08.01.03-VALP-1001 is obtained through FTS. The prepared traffic sample is executed in RAMS and, based on its outputs, an optimised DAC sector configuration proposed.
- Preparation of RNEST scenarios. The airspace design and sector configuration of the solution scenarios SCN-08.01.03-VALP-2001, SCN-08.01.03-VALP-1002 and SCN-08.01.03-VALP-2002 are obtained through FTS in RNEST. The prepared traffic sample

is evaluated in RNEST and DAC optimal configuration and DMA Type 1 location are proposed by the tool.

- Elaboration of this Validation Plan.
- Development and preparation of the platform to support the exercise including the preparation of the data adaptation to model new airspace designs.
- Exercise modelling and other preparatory activities, including:
  - the configuration and validation of the scenarios in iTEC platform;
  - definition of data gathering methods including questionnaires, structured interviews and data logs.
  - A dry-run to test all the prototype functionalities
  - Traffic preparation and refinement
  - Preparation of briefing and training material.

5.3.9.1.1.2 Execution activities

The main execution activities are described below:

- Training. In order to ensure that the ATCo are used to the platform functionalities.
- Validation exercise execution.
- Data collection, according to the methods selected during the preparatory phase, including questionnaires, debriefing sessions, interviews and data recording.

5.3.9.1.1.3 Post-execution activities

The main post-execution activities are described below:

- Post-processing of data
- Analysis of collected data obtained during the exercise execution.
- Elaboration of Validation Report, including the work done, the results obtained and the conclusions.

5.3.9.2 Roles & Responsibilities in the exercise

In terms of roles implicated in the validation exercise, ENAIRE identifies the following roles:

- The airspace design expert. The airspace design expert is in charge of the elaboration and preparation of the solution scenarios. Workload assessment and airspace design tools will be managed by the airspace design expert for this purpose.
- The platform integrator. The platform integrator is the responsible for all the aspects of the platform preparation and installation.
- The supervisor. The supervisor is in charge of the start and operation of the platform during the testing phase and is involved in the execution of the training and execution runs.
- The operational expert. The operational expert is in charge of the operational coherence and feasibility of the experimental environment.
- The software engineer. The software engineer is responsible for developing the technical components and assists the platform integrator for testing the implemented validation environment. Additionally, the software engineer supports the execution of the validation exercises.

- The human factors expert. The HF expert is responsible for the organizational aspects like time planning, resource planning, briefing material and questionnaires.
- Technical staff. Technical staff is responsible for the definition of the exercise, elaboration of Validation Plan and Report, and the analysis of the results based on the data collected.
- Operational staff is the responsible of execute the exercise, run the scenarios and provide feedback in the debriefing sessions.

In terms of responsibilities, ENAIRE is the leader of EXE 08-01.03, and is the responsible for the coordination between all partners involved in this exercise.

The main tasks in which ENAIRE is involved in this validation activity are the following:

- Definition of the validation exercise plan in accordance to PJ08 OSED[37] .
- Definition of the scenarios.
- Coordinate the contributions of other partners to the scenario preparation task.
- Preparation of the material to collect validation results such as questionnaires, structures interviews and debriefing sessions.
- Monitoring the conduction of the training sessions as well as execution of the validation exercise.
- Provision of operational staff for the exercise execution
- Operational validation of the exercise validation platform
- Lead the post-processing of the outputs.
- Lead the analysis of the exercise results.
- Lead the elaboration of the Validation Report

EUROCONTROL participation in this activity (preparation of EXE#3) is:

- DAC tool general support in an RNEST environment (i.e. usage of DAC algorithms to create automatic sectorisation)
- Provision of military expertise for airspace design
- Design of VPA and DMAs airspace in an RNEST environment
- Generation of RNEST rerouted traffic samples around active VPA & DMAs
- Contribution to Validation Plan scenario definition, including the full VPA & DMAs design methodology and proposals for validation scenarios.

INDRA partipation involves:

- Preparation of the data adaptation in the platform
- Installation of iTEC platform instance in CRIDA premises to support the validation
- Development of the ATC supporting tool
- Integration of COMETA complexity evaluation into the iACM
- Support in the configuration of the platform scenarios, configuration of the tool parameters and usage of the platform.

o

5.3.9.3 Time planning

EXE 08-01.03 main activities will be carried out between Q4 2018 and Q1 2019, but preparatory activities have started in Q3 2017. A detailed time planning of the validation exercise is shown in **Table 70**.

Group of activities	Activity	2017					2018												2019					
		A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Preparatory activities	Definition of the exercise	X	X	X	X	X	X	X																
	Traffic preparation				X	X	X	X	X	X	X	X	X	X										
	Preparation of RAMS scenarios				X	X	X	X	X	X	X	X	X	X	X	X								
	Preparation of RNEST scenarios											X	X	X	X	X	X	X						
	Elaboration of VALP	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
	Platform Develop.							X	X	X	X	X	X	X	X	X	X	X	X					
	Prototype testing																	X	X					
	Modelling of the exercise																	X	X	X	X			
Execution activities	Training																				X			
	Run execution																				X			
	Data collection																				X			
Post-Execution activities	Post-processing of data																					X	X	
	Analysis of results																					X	X	
	Elaboration of VALR																					X	X	X

Table 70: Detailed time planning

5.3.9.4 Identified Risks and mitigation actions

Risks	Impact (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High)	Probability (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High)	Mitigation Actions
Risk #01 (Risk 6 PMP) Delay in Exe 08.01.03	4-High	3-Medium	Ensure concept aspects can be properly addressed with the exercise means Collaboration between EXE08.01.02 and EXE08.01.03. Measures to re-scope the exercise will also be jointly analysed.
Risk #02 Need for a free route traffic sample in a route structured airspace which is not validated	4-High	4-High	Use of PJ06.01 free route traffic samples Coordination with PJ06 to identify when the sample will be available and validated Identify compatibility of data between iTEC, PJ06 traffic sample and RNEST.
Risk #03 Late availability of RNEST tool for the airspace design	4-High	4-High	Training course on RNEST for the preparation of the scenarios with RNEST EUROCONTROL support for the usage RNEST tool EUROCONTROL will prepare DMA relate scenarios Preparation of airspace design with other FTS tool

Table 71: Risks and mitigation actions

5.4 Validation EXE-08.01-V2-VALP-004 Plan

The validation exercise plan has been developed under the scope of EXE-08.01-V2-VALP-004 "DAC Performance assessment with DMA Type 2/Refined capacity performance assessment of the improved Sector Design and Sector Configuration".

5.4.1 Validation Exercise description and scope

EXE-08.01-V2-VALP-004 is the second validation activity planned within the framework of PJ-08 solution 01 to contribute to reach the PJ-08 V2 maturity level. The exercise addresses the operational concept of Dynamic Airspace Configuration (DAC), and particularly the concept of Dynamic Mobile Area (DMA) of type 2, for SESAR Solution 08.01 which is considered as part of ATM System.

The main purpose of the exercise is to carry out a performance assessment in order to assess the En-route capacity, fuel efficiency, cost effectiveness, civil/military cooperation and technical feasibility of the DAC including DMA Type 2 design principles intended to facilitate civil and military requirements, with the overall goal of generating an optimised airspace configuration.

The validation activities for exercise EXE-08.01-V2-VALP-004 are planned in two parts and the current document version is mainly focusing on the first part.

Part 1 will focus on the performance and operational feasibility of DAC and DMA (Type 2). This will involve modelling using the MUAC airspace, chosen to represent[4] a free route environment of complex traffic situations on a day to day basis with varying conflict trajectories. The airspace will be modelled in R-NEST using high-level workload/complexity function in order to devise an optimised sector configuration based on the SBB and SAM concept and will validate the performance, operational and technical feasibility of the DAC and DMA's.

The principle objective of **Part 2** will be to build upon the output of part one and, using the same airspace environment, carry out an initial evaluation of dynamicity of the DAC elements, associated with mission trajectory development and management and will focus in particular on the extension of dynamic, cross-border airspace management for DMA Type 2 and its impact linked to civil-military coordination and collaboration. This assessment will be done through fast-time simulation, if feasible, with AirTOp. The outcome will be corroborated by operational and expert opinion. The idea is to identify some needs in term of support tools to be prepared for the exercise EXE-08.01-V2-VALP-002.

It is expected that this exercise relies on the output of the capacity performance assessment of exercise EXE-08.01-V2-VALP-001 on DMA Type 1 to further refine/investigate the capacity performance assessment, if needed.

[4] Free Route operations are not yet applied in MUAC airspace, specific traffic has been generated with free route characteristics (refer to §5.4.6.1)

EXE-08.01-V2-VALP-004 is led by EUROCONTROL, providing the validation platforms, and supported by AIRBUS and NATS in the preparation of the exercise.

This exercise is addressing similar objectives to EXE-08.01-V2-VALP-001 while bringing more complexity by introducing in scenarios DMAs Type 2. It starts from the current maturity level (i.e. initial V2) and should contribute to reach the full V2.

The addressed OIs and associated enablers are summarised below in Table 72.

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)	Required v Optional*
SESAR Solution 08.01	Management of Dynamic Airspace Configurations	C	**Solution 08.01 focuses on validation of Dynamic Airspace Configurations (DAC) and Dynamic Mobile Areas (DMAs) of types 1 and 2 in FRA that enable flexible solutions that can be dynamically adapted to traffic demand to respond to different regional/local performance objectives, which may vary in time and place up to concept maturity level 2**	**AOM-0208-B**	AAMS-16a	R
					PRO-146	O
				AOM-0805	AAMS-13	R
					NIMS-04	R
				AOM-0809	AAMS-13	R
					NIMS - 04	R

**Although not required by EATMA, the project has identified the enablers that will be developed during the project's lifecycle and those which will be used during the validation activities.*

Table 72: OIs and Enablers addressed in Validation Exercise EXE-08.01-V2-VALP-004

The operational concepts and Use Cases addressed by the exercise are defined in the SESAR Solution 08.01 OSED Part I [37]:

- Section 3.3.2.1: Dynamic Sectorisation;
- Section 3.3.2.2: Dynamic Mobile Areas;
- Section 3.3.2.8: Uses Cases
  - UC07: Impact assessment;
  - UC09: DAC publication/update[5];

[5] These Use Cases are partially addressed in Part 2, linked to the evaluation of needs for support tools and support to preparation of EXE-08.01-V2-VALP-002.

- UC10: DAC Changes assessment[5];
- UC11: Final DAC publication[5].

5.4.2 Stakeholder's expectations and Benefit mechanisms addressed by the exercise

Stakeholder	Involvement	Why it matters to stakeholder
European Network Manager	Direct involvement, as part of the concept and validation teams.	The wish to ensure effective cooperation between all the stakeholders in moving towards an optimised airspace configuration. Ensure that the DAC & DMA Type 2 design is workable. Wish to ensure feasibility of the tools, processes and procedures involved in the DAC & DMA Type 2 design. Interested in assessing the impact of military activities on the Network capacity (at local level) through improved management of available airspace.
ANSP (NATS)	Participating in definition and refinement of concept. Contributing to the validation exercise.	Interested in the optimised use of airspace and wish to increase airspace capacity through Dynamic Airspace Configurations including Dynamic Mobile Areas Type 2 supported by automated tools. Wish to improve cost efficiency through optimum use of available human resources. Ensure that safety is maintained. Ensure operational feasibility and potential benefits of DAC.
Airspace Users	No direct involvement in the exercise. However, interested in the outcome.	Interested in achieving fuel efficiency. Check DMA Type 2 design principles are compatible with DAC. Interested in the flexible use of airspace on a day-to-day basis. Impact of flight trajectories on allocated DMAs.
Military Airspace Users	Direct involvement, as part of the concept and validation team.	Flexible access to airspace by relying on the responsiveness of airspace management. Military operational training capabilities will be maintained with the DAC & DMA Type 2 principles. Performance improvements to civil stakeholders will potentially lead to military flight and operational efficiency improvements.
European Commission	Direct involvement through the SJU	Have evidence of benefits or potential drawbacks of DAC & DMA Type 2 design.

Table 73: Stakeholders' expectations addressed in Validation Exercise EXE-08.01-V2-VALP-004

The benefit mechanism identified for the concept improvements [37] targeted by the exercise are presented in the Figures below. It should be noted that for Part 1, given that the exercise is performed using a modelling tool, some indicators/KPAs presented in the diagrams cannot be addressed (black shaded in diagram). These aspects should be covered by other validation exercises of Solution 01.

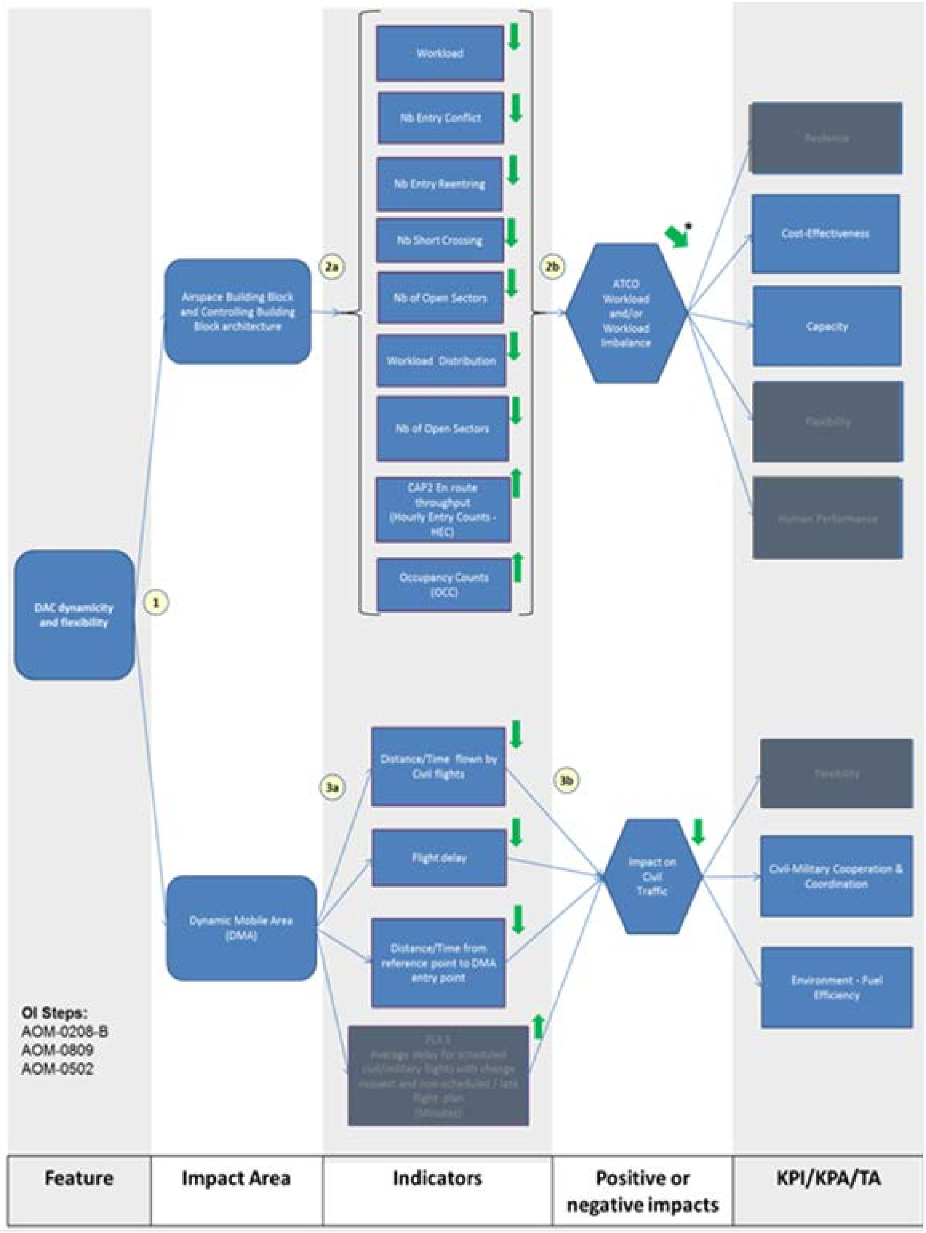


Figure 39: Benefit Impact Mechanism addressed by EXE-08.01-V2-VALP-004 (DAC level dynamicity)

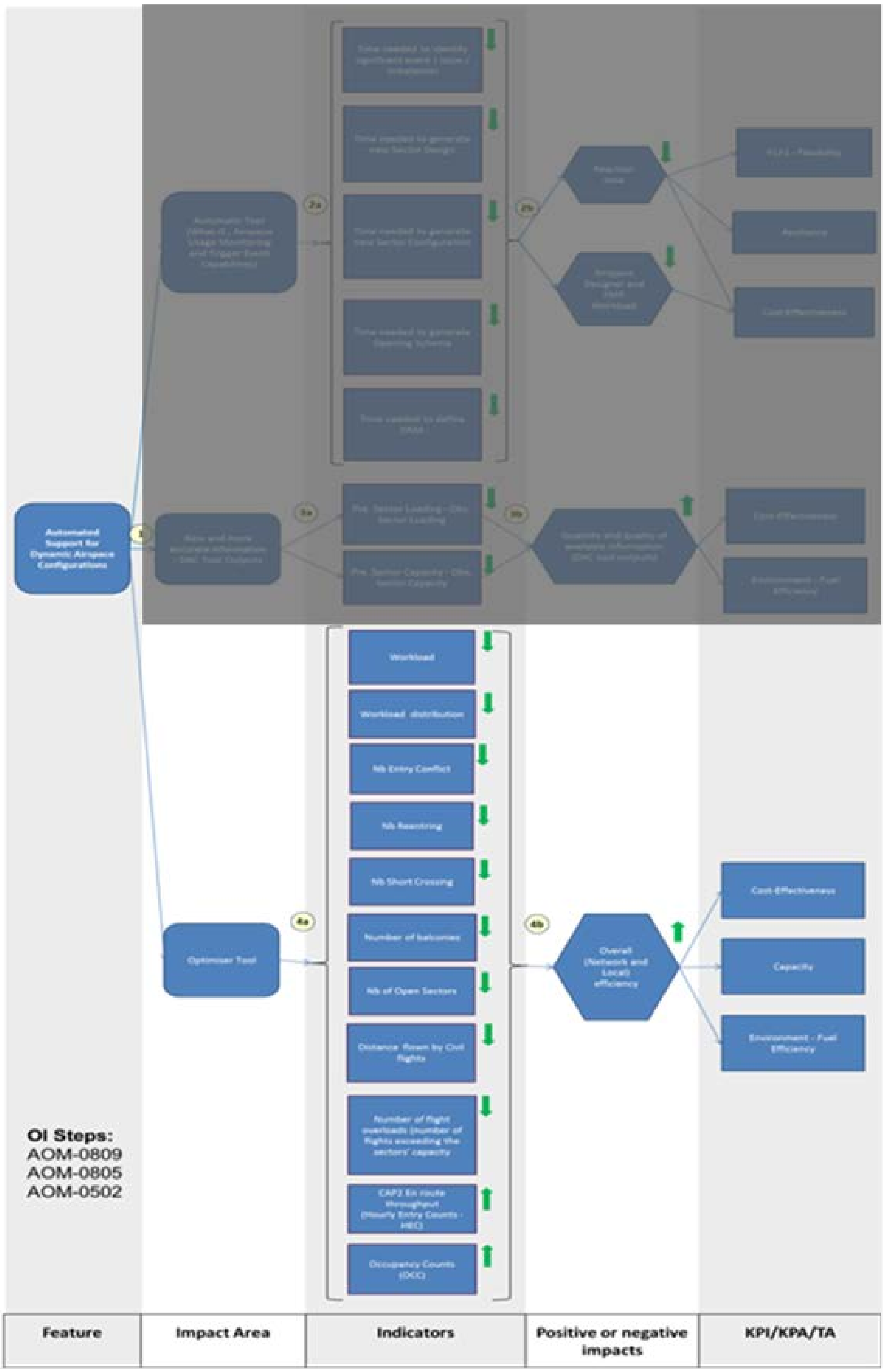
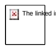
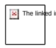
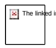


Figure 40: Benefit Impact Mechanism addressed by EXE-08.01-V2-VALP-004 (Automated Support for DAC)

5.4.3 Validation objectives

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments on the coverage of SESAR Solution Validation Objective in Exercise #04	Exercise Validation Objective	Exercise Success criteria	Phase – Part 1	Phase – Part 2
OBJ-08.01-V2-VALP-PE1	CRT-08.01-V2-VALP-PE1-001	Partially covered as only covering DMA Type 2 and CRT-08.01-V2-VALP-PE1-002 not covered	**EX4-OBJ-08.01-V2-VALP-PE1-001** To assess whether the DAC & DMA in FRA environment leads to an increase in En-route capacity due to a better airspace configuration which is optimising the use of available airspace.	**EX4-CRT-08.01-V2-VALP-PE1-001** DAC & DMA increases En-route capacity in nominal conditions under Free Route Airspace.		
	CRT-08.01-V2-VALP-PE1-003		**EX4-OBJ-08.01-V2-VALP-PE1-003** To determine if cost efficiency is increased, assuming that a more optimised airspace configuration will lead to improved use of sectorisation opening scheme and ATCO work force.	**EX4-CRT-08.01-V2-VALP-PE1-003** A more optimised airspace configuration will increase number of the flight per ATCO hours		
	CRT-08.01-V2-VALP-PE1-004		**EX4-OBJ-08.01-V2-VALP-PE1-004** To assess whether safety standards remain the same.	**EX4-CRT-08.01-V2-VALP-PE1-004** Safety is not degraded (at least number of pre tactical conflict remains equivalent) and common situation awareness may be increased due automated tools. (no target)		

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments on the coverage of SESAR Solution Validation Objective in Exercise #04	Exercise Validation Objective	Exercise Success criteria	Phase	
					Part 1	Part 2
	CRT-08.01-V2-VALP-PE1-005		**EX4-OBJ-08.01-V2-VALP-PE1-005** To assess if the DAC and DMA Type 2 have any positive impact on fuel burn because of better allocation of airspace (including FRA).	**EX4-CRT-08.01-V2-VALP-PE1-005** Optimised flight trajectories and better allocation of DMA leads to reduced fuel burn. (Fuel efficiency - there is no target).		
	CRT-08.01-V2-VALP-PE1-006		**EX4-OBJ-08.01-V2-VALP-PE1-006** To investigate the impact of the DAC & DMA on civil/military collaboration and coordination.	**EX4-CRT-08.01-V2-VALP-PE1-006** Improved civil-military collaboration and coordination enables optimized use of airspace to benefit all airspace users.		
OBJ-08.01-V2-VALP-TF1	CRT-08.01-V2-VALP-TF1-001	Partially covered as only covering DMA Type 2 and CRT-08.01-V2-VALP-TF1-002 not covered	**EX4-OBJ-08.01-V2-VALP-TF1-001** To carry out an initial assessment on the most appropriate automated tools and their impact for DAC and DMA.	**EX4-CRT-08.01-V2-VALP-TF1-001** The definition of requirements for automated support tools to support the actors activity		
	CRT-08.01-V2-VALP-TF1-002		**EX4-OBJ-08.01-V2-VALP-TF1-002** To carry out an initial assessment on the usability of automated tools provided to support the designation of the most optimised airspace configurations	**EX4-CRT-08.01-V2-VALP-TF1-002** The automated tools provided to assess, and compare the different airspace configurations are fit for use and support the actors in their decision- making tasks.		

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments on the coverage of SESAR Solution Validation Objective in Exercise #04	Exercise Validation Objective	Exercise Success criteria	Phase	
					Part 1	Part 2
	CRT-08.01-V2-VALP-TF1-003		**EX4-OBJ-08.01-V2-VALP-TF1-003** To assess the feasibility and usability of automated tools for monitoring the implemented DAC solutions.	**EX4-CRT-08.01-V2-VALP-TF1-003** Automated tools for implemented airspace configurations monitoring are fit for use and support the actors in their interactions.		
OBJ-08.01-V2-VALP-OF1	CRT-08.01-V2-VALP-OF1-003	Partially covered as only covering DMA Type 2 and CRT-08.01-V2-VALP-OF1-002, CRT-08.01-V2-VALP-OF1-001 not covered	**EX4-OBJ-08.01-V2-VALP-OF1-003** To assess the acceptability of DMA Type 2 design principles integrated into DAC for a defined areas of by the different actors involved	**EX4-CRT-08.01-V2-VALP-OF1-003** The exercise provides evidence that the DMA Type 2 design principles are acceptable		
OBJ-08.01-V2-VALP-C01	CRT-08.01-V2-VALP-CO1-001	Partially covered as only covering DMA Type 2 and CRT-08.01-V2-VALP-CO1-002 not covered	**EX4-OBJ-08.01-V2-VALP-CO1-001** To assess the operational feasibility and performance benefits of DAC & DMA Type 2 structures and use in Free Route Airspace.	**EX4-CRT-08.01-V2-VALP-CO1-001** The operational feasibility of the optimised configurations and the performance benefits generated by DAC & DMA Type 2 integrated into Free-Route environment is established.		
	CRT-08.01-V2-VALP-CO1-003		**EX4-OBJ-08.01-V2-VALP-CO1-003** To assess that the DMA Type 2 design principles are compatible with mission trajectory	**EX4-CRT-08.01-V2-VALP-CO1-003** The exercise provides evidence that the DMA Type 2 allocation principles are compatible with the business and mission trajectory.		

Table 74: Validation Objectives addressed in Validation Exercise EXE-08.01-V2-VALP-004

5.4.4 Validation scenarios

This section is presenting the scenarios proposed for EXE-08.01-V2-VALP-004 (i.e. Part 1 and Part 2), however the current version of the document is only focusing on the modelling part (i.e. Part 1).

5.4.4.1 Scenarios for Part 1

As mentioned in §5.4.3 one of the main objectives of the exercise is the assessment of DAC including DMA Type 2, thus scenarios described in this section will address equally civil traffic demand and military mission requirements.

The civil traffic sample used in Part 1 (so-called "cloned reference traffic") is using the traffic developed for EXE-07.05.04-VP-718. The traffic has been imported into current AIRAC 426 (i.e. 25th May 2017 to 21st June 2017). The busiest day of traffic (i.e. 02 June 2017) has been cloned with STATFOR 2023 base scenario assumptions. The resulting traffic is presented in the Figure below:

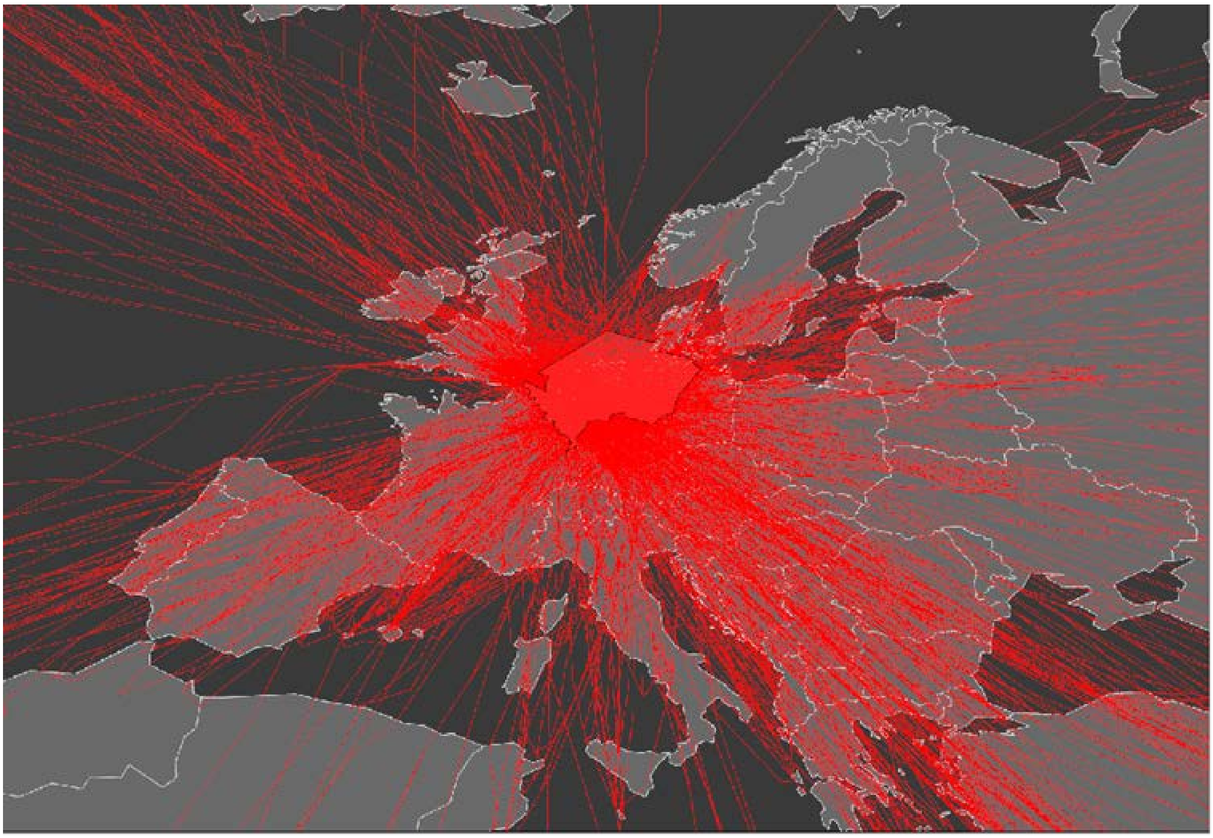


Figure 41: Cloned reference traffic for Reference & Solution scenarios

The military activities are performed in German airspace of MUAC area. The location of the areas used for the mission is restricted to the national and delegated airspace of Germany (i.e. no cross-border area used).

The requests from the military users are related to 3 types of missions:

- Performing Air Combat Training (ACT) ;
- Performing Basic Fighter Manoeuvring (BFM);
- Performing Air to Air Refuelling (AAR) missions.

Each of the following scenarios reflects the type of missions and the corresponding DMAs, embedded where suitable, in trajectories.

The generic storyboard from the military component is as follows:

> *Wittmundhafen (Alpha formation) and Nordholz (Bravo formation) Fighter Squadron leaders request their respective WOCs to plan the required for the missions' airspace and the corresponding trajectories (MTs) for combined missions. The squadrons are performing training activities with Eurofighter aircraft for ACT, BFM and AAR missions combined in various sequences as described in the scenarios below.*

Coordination with tanker aircraft deployed at Wunstorf Air Base is requested by both formations.

CDM is performed amongst all relevant actors and the resulting airspace planning for D_{Ops} is presented in the following scenarios. Planning results reflect the situation at D_{ops}-1

The actors involved in the storyboard are:

- WOC operators;
- Local DAC operators.

Military airspace users involved in the storyboard are:

- An AMC/DFS;
- A Fighter Squadron Eurofighter Typhoon and a WOC, located on Wittmundhafen Air Base (ETNT);
- A Fighter Squadron Eurofighter Typhoon and a WOC, temporary deployed on Nordholz Air Base (ETMN);
- An Airlift Squadron operating A400M tankers[6] and a WOC, located on Wunstorf Air Base (ETNW).

From these initial requirements from the military users various alternatives might have been defined and discussed during the planning phase (prior to D_{ops}). These internal negotiations are considered ended leading to results/outputs which are proposed in the various scenarios described below. During the actual runs of the scenarios, negotiation process (i.e. CDM) will be neither applied nor simulated.

It is assumed that during initial planning, WOC actor is widely using the functions of "What-if" tool for simulation of DMAs design, position and mission synchronisation. It is also assumed that WOC actors interact with local DAC actor to perform CDM for the changes required to the configurations of DMAs.

[6] Tanker will fly civil route to/from ARES/DMA.

For impact assessment purposes, a DMA location tool (refer to §5.4.6.4 & §5.4.6.6) could be used. The exercise will use such a tool in order to evaluate the best location of the DMAs thanks to the known civil traffic demand[7].

For each DMA configuration (i.e. proposed and calculated) the induced BTs modifications of the civil traffic demand is evaluated. For this process the global MUAC airspace (Figure 42) is considered beyond the limited German airspace designated for military activities. This will enable a more realistic re-routing mechanism (i.e. BT modification) where the potentials impacts on the sectorisation of MUAC ACCs[8] (i.e. HUTA & DUTA Figure 43) are evaluated.

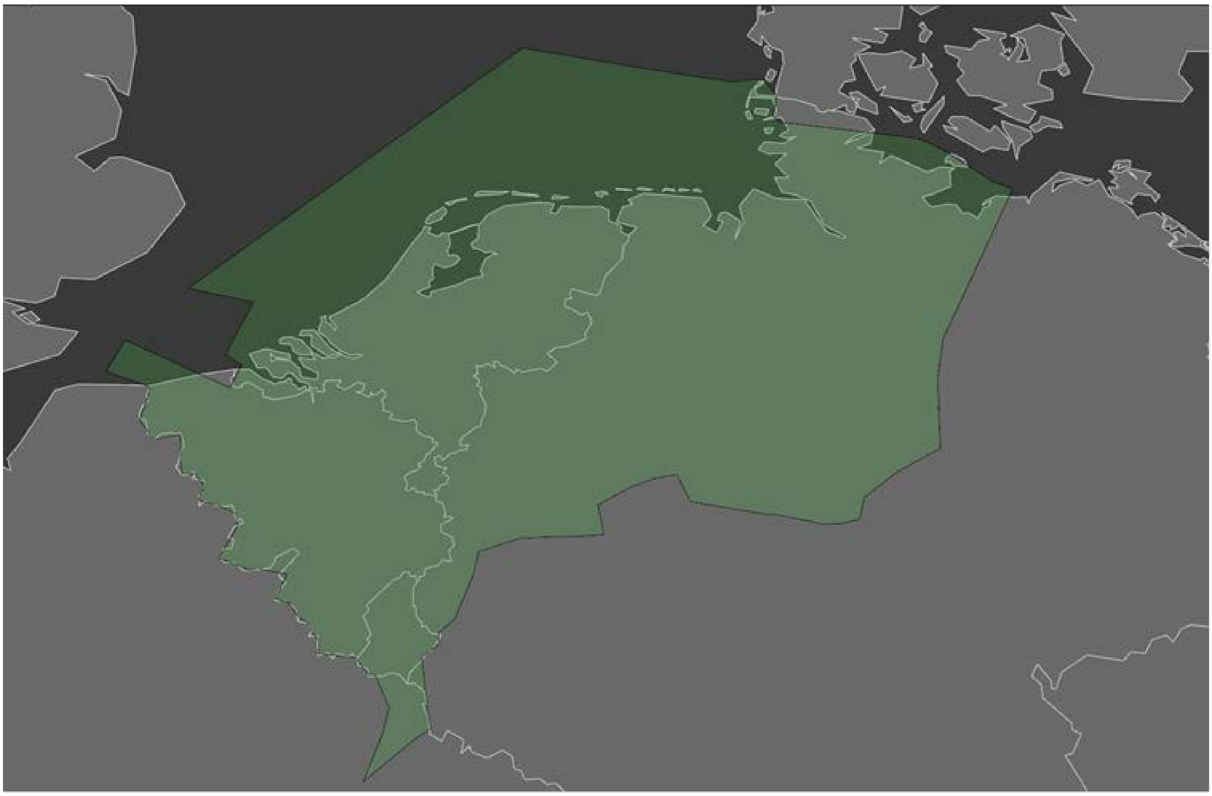


Figure 42: MUAC Free Route airspace for Reference and Solution scenarios

The first reference is based on the sectorisation currently used (so-called "Reference configuration") for MUAC ACCS (i.e. EDYYHUTA and EDYYDUTA) and presented in Figure 43.

[7] Civil traffic demand is the traffic build for EXE-07.05.04-VP-718 and extended to 2035 forecast using MTF STATFOR base scenario data [40].

[8] The assumption (refer to § 5.4.5) that the impact from the BT modification process will be low for traffic in BUTA airspace has been made.

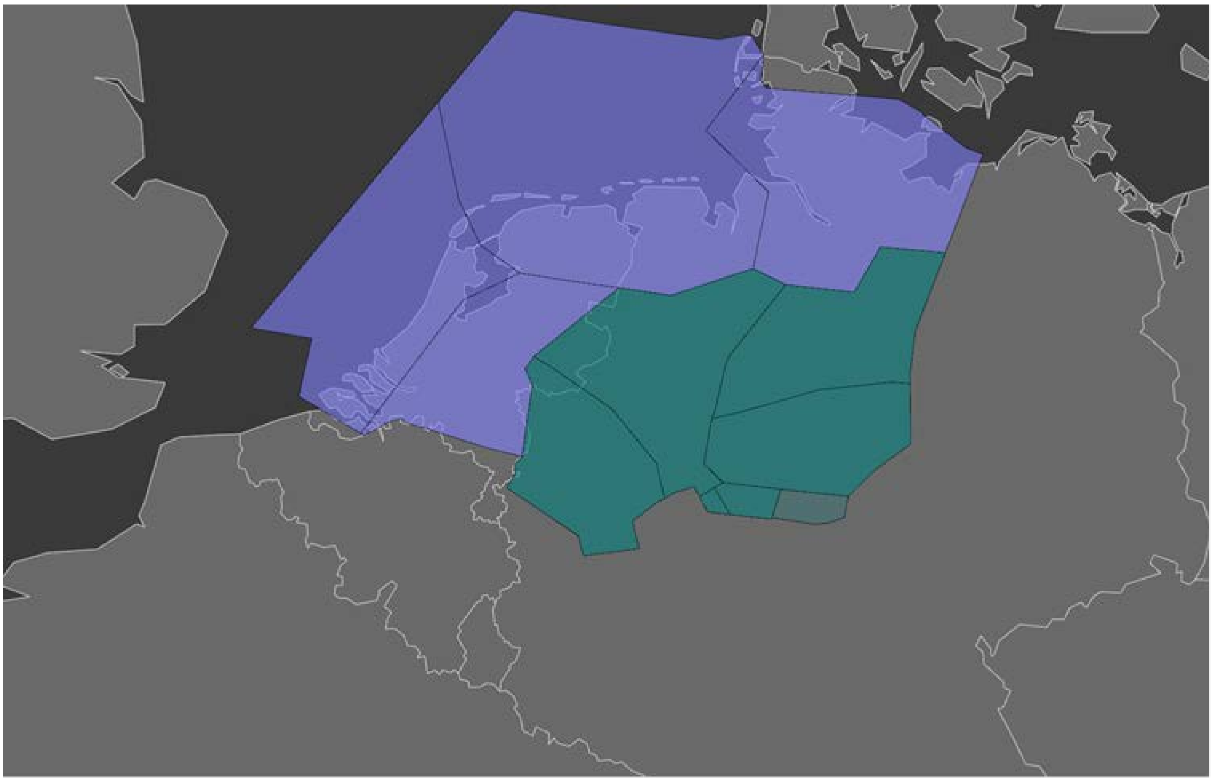


Figure 43: EDYYHUTA & EDYYDUTA current airspace

The second reference is based on a sectorisation obtained through a DAC process (so-called "DAC reference configuration") using the cloned reference traffic for EDYYHUTA and EDYYDUTA ACCs.

The various scenarios identified for EXE-08.01-V2-VALP-004 Part 1 are summarised in the Table below and have been split in order to consider DMA and DAC processes independently.

Identifier	Scenario
SCN-08.01.04-VALP-0001	Current static ARES activation with reference configuration (Reference scenario #01)
SCN-08.01.04-VALP-0002	Current static ARES activation with DAC reference configuration[9] (Reference scenario #02)
SCN-08.01.04-VALP-1001	DMA configuration using similar volumes to reference ARES and optimised location supported by automated tools (Solution scenario #01)
SCN-08.01.04-VALP-1011	DAC supported by automated tools on DMA amended traffic from Solution scenario SCN-08.01.04-VALP-1001 (Solution scenario #02)

[9] Sectorisation generated using DAC supported by automated tools on cloned reference traffic.

Identifier	Scenario
SCN-08.01.04-VALP-1002	DMA configuration location and optimised location supported by automated tools (Solution scenario #03)
SCN-08.01.04-VALP-1012	DAC supported by automated tools on DMA amended traffic from Solution scenario SCN-08.01.04-VALP-1002 (Solution scenario #04)
SCN-08.01-04-VALP-1003	DMA overlapping configuration location and optimised location supported by automated tools (Solution scenario #05)
SCN-08.01-04-VALP-1013	DAC supported by automated tools on DMA amended traffic from Solution scenario SCN-08.01.04-VALP-1003 (Solution scenario #06)

Table 75: EXE-08.01-V2-VALP-004 scenario list

5.4.4.1.1 Reference Scenarios

The reference scenarios are focusing on operations performed in static reserved airspace and describe the use of ARES based on the mission needs as requested by squadrons. It is assumed that there are no time constraints defined for the waypoints of the trajectories performed for mission accomplishment:

- Selected military area is TRA 302 (WESER 2) as depicted in Figure 44;
- Cloned reference traffic.

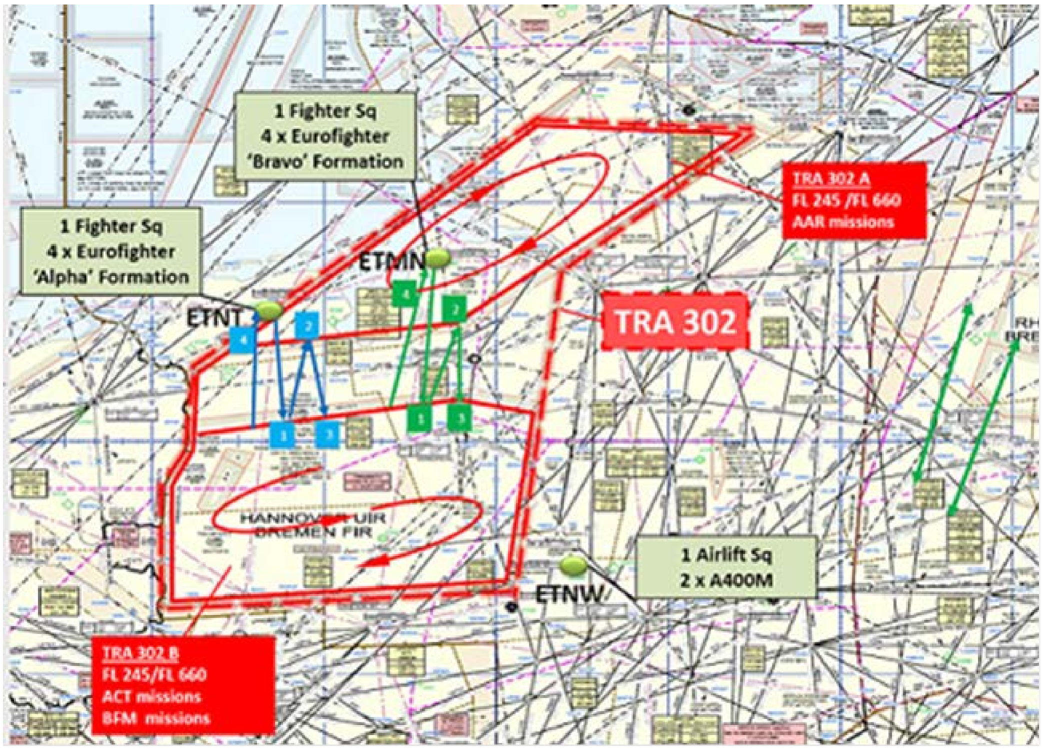


Figure 44: Definition for ARES TRA302 and use by military users in Reference scenarios

The scenario is composed of 2 "sorties"; Alpha formation (blue) and Bravo formation (green):

- Route blue: ETNT – Entry TRA 302B – Exit TRA 302B – Entry TRA 302A – Exit TRA 302A – Entry TRA 302B – Exit TRA 302B – ETNT;
- Route green: ETMN – Entry TRA 302B – Exit TRA 302B – Entry TRA 302A – Exit TRA 302A – Entry TRA 302B – Exit TRA 302B – ETMN.

The associated Mission Trajectories are described in Table 76.

MT	ADEP	Entry 1st ARES	ARES List[10]	Aircraft Type	# of Aircraft	ADES
MT1	ETNT	14:00	TRA 302B (40 minutes) TRA 302A (40 minutes) TRA 302B (60 minutes)	fighters	4	ETNT
MT2	ETNW	14:40	TRA 302A (40 minutes)	tanker	1	ETNW
MT3	ETMN	15:20	TRA 302B (60 minutes) TRA 302A (40 minutes) TRA 302B (40 minutes)	fighters	4	ETMN
MT4	ETNW	16:20	TRA 302A (40 minutes)	tanker	1	ETNW

Table 76: MTs defined for Reference scenarios

The proposed activation periods of ARES for D_{ops} is summarised in the Table below.

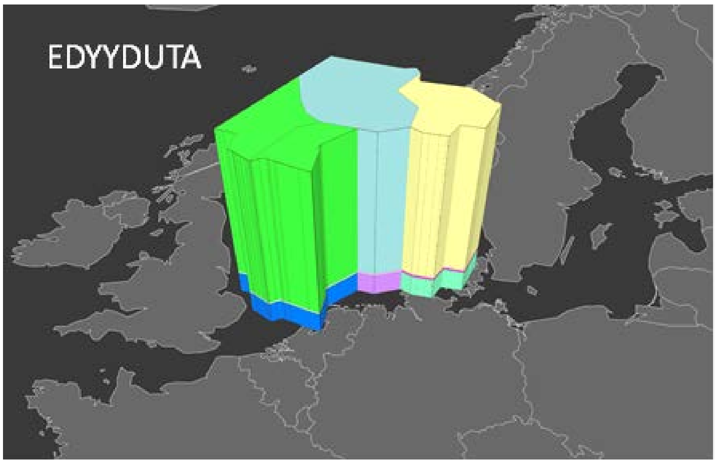
ARES	Min FL	Max FL	Start	End	Mission
TRA 302A	245	660	14:00	17:40	Alpha formation 1 tanker ETNW (AAR)
TRA 302A					Bravo formation 1 tanker ETNW (AAR)
TRA 302B	245	660	14:00	17:40	Alpha formation (BFM)
					Alpha formation(ACT)
TRA 302B					Bravo formation (BFM)
					Bravo formation (ACT)

Table 77: ARES description for Reference scenarios

5.4.4.1.1.1 Reference scenario #01

The reference scenario (SCN-08.01.04-VALP-0001) is built with the Reference configuration of MUAC airspace. The current sectorisation for MUAC ACCs is presented below in Figure 45.

[10] Time in brackets is the time spent in the ARES.



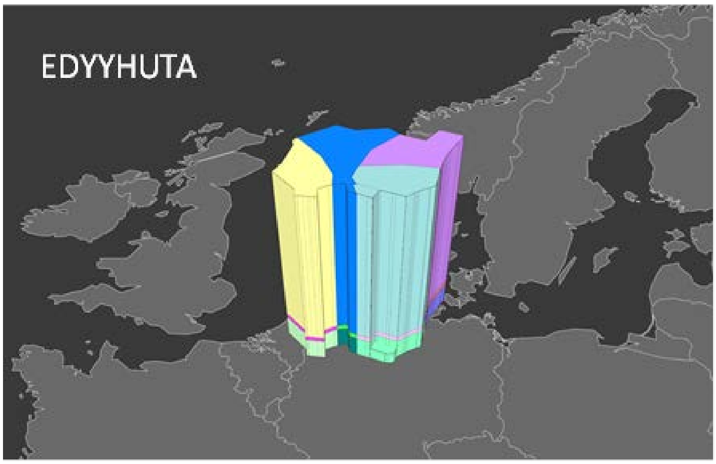


Figure 45: Sectorisation from DUTA and HUTA ACCs (current sectorisation)

The BT modification process is done as follows:

Run	Description	Comment
01	ARES reservation as planned and routes blue and green are activated. Evaluation of the civil traffic BTs modifications not constrained.	Safety buffer: None Intermediate points not kept.

Table 78: Reference scenario #01

5.4.4.1.1.2 Reference scenario #02

The reference scenario (SCN-08.01.04-VALP-0002) is built with the DAC reference configuration of MUAC airspace.

The exercise is restricted to a DAC-level 2 implementation in the vertical plan only.

In the lateral plan, it is restricted to the configuration of elementary sectors (i.e. no lateral SAM or SBB).

The DAC reference configuration has been build using DAC-level 2 process applied to the 2 ACCs EDYYHUTA & EDYYDUTA independently (i.e. ACCs not merged).

The initial configurations used for DAC process (i.e. SAM & SBB definition) are those coming from EXE-07.05.04-VP-718 exercise [38].

The vertical SAMs for DUTA & HUTA consist of two 1000ft layers:

- SBBs are defined from FL245 to FL335 and FL355 to FL500;
- SAMs are defined from FL335 to FL345 and FL345 to FL355.

Since the SAMS consist of only two 1000ft Layers, this qualifies as Level 2 implementation since SAM's exist to provide a degree of flexibility but the airspace structure is mainly devised of SBB.

The BT modification process is done in the same way as in Reference scenario #01:

Run	Description	Comment
01	ARES reservation as planned and routes blue and green are activated. Evaluation of the civil traffic BTs modifications not constrained.	Safety buffer: None Intermediate points not kept.

Table 79: Reference scenario #02

5.4.4.1.2 Solution Scenarios

Solution scenarios defined in this section will be compared against the Reference scenarios defined in the previous section (§5.4.4.1.1).

There are four configurations selected for military activities which are defining the four solution scenarios proposed below.

The military airspace used for the DMA and military activities is presented in the Figure below.

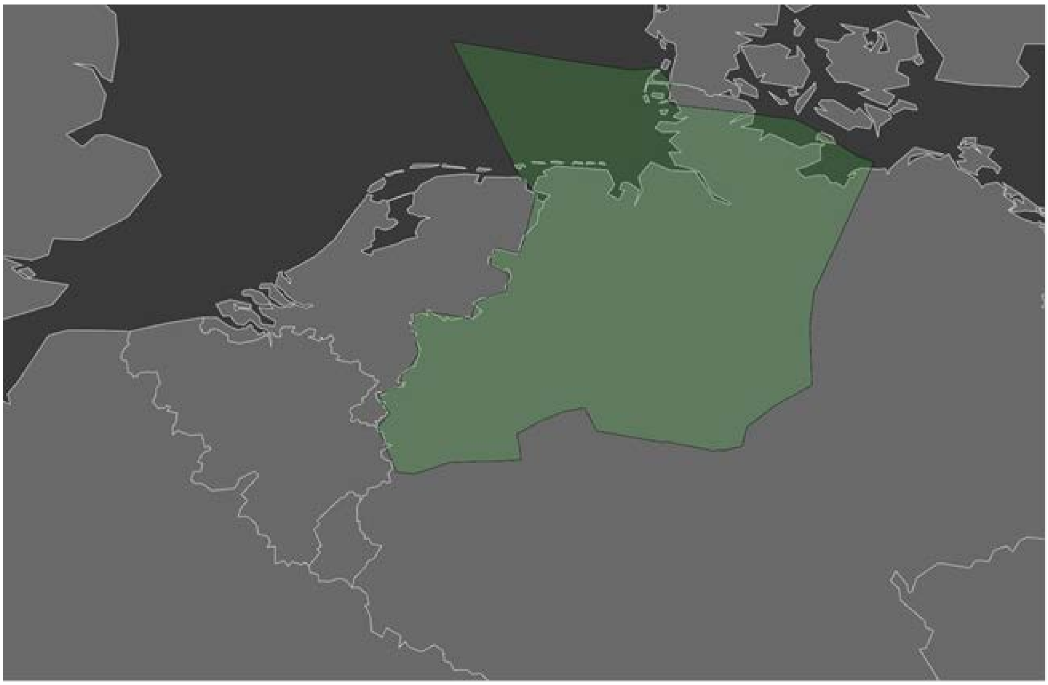


Figure 46: German airspace dedicated to military activities in Solution scenarios

In order to evaluate the DMA Type 2 concept and show its potential benefits, several DMAs are defined to build the four scenarios as presented in Figure 47 below.

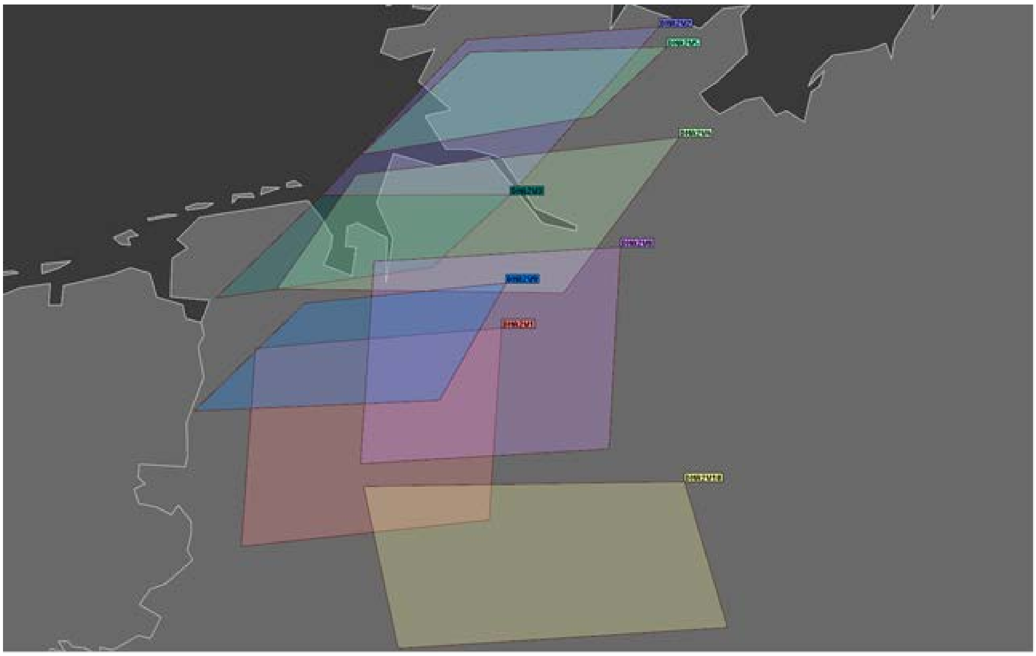


Figure 47: DMAs identified in the scenarios

The main 2D characteristics[11] of these DMAs are summarised in the Table below.

Note: The Flight Level values and negotiable parameters are defined in each scenario.

DMA	Custom Shape	Negotiable	Mission Type	Solution Scenario(s)
DMA2W1	DMA2W11 (52°17’00”N; 007°24’00”E) DMA2W12 (53°07’00”N; 007°35’00”E) DMA2W13 (53°09’00”N; 009°16’00”E) DMA2W14 (52°21’00”N; 009°06’00”E)	**True**	ACT	Scenario #01 Scenario #03 Scenario #05
DMA2W2	DMA2W21 (53°44’00”N; 008°06’00”E) DMA2W22 (54°20’00”N; 009°10’00”E) DMA2W23 (54°20’00”N; 010°30’00”E) DMA2W24 (53°42’00”N; 009°23’00”E)	**True**	AAR	Scenario #01
DMA2W3	DMA2W31 (53°20’00”N; 007°20’00”E) DMA2W21 (53°44’00”N; 008°06’00”E) DMA2W24 (53°42’00”N; 009°23’00”E) DMA2W34 (53°26’00”N; 008°50’00”E)	**True**	BFM	Scenario #01
DMA2W4	DMA2W41 (53°22’00”N; 007°45’00”E) DMA2W42 (53°49’00”N; 008°21’00”E) DMA2W43 (53°53’00”N; 010°35’00”E) DMA2W44 (53°17’00”N; 009°43’00”E)	**True**	AAR	Scenario #03
DMA2W5	DMA2W51 (53°54’00”N; 008°23’00”E) DMA2W52 (54°17’00”N; 009°11’00”E) DMA2W53 (54°15’00”N; 010°32’00”E) DMA2W54 (54°00’00”N; 010°00’00”E)	True	BFM	Scenario #03 Scenario #05
DMA2W8	DMA2W81 (52°37’00”N; 008°15’00”E) DMA2W82 (53°27’00”N; 008°26’00”E) DMA2W83 (53°27’00”N; 010°07’00”E) DMA2W84 (52°37’00”N; 009°57’00”E)	True	ACT	Scenario #05
DMA2W9	DMA2W91 (52°52’00”N; 007°08’00”E) DMA2W92 (53°18’00”N; 007°56’00”E) DMA2W93 (53°20’00”N; 009°19’00”E) DMA2W94 (52°52’00”N; 008°49’00”E)	True	BFM	Scenario #05
DMA2W10	DMA2W101 (51°49’00”N; 008°26’00”E DMA2W102 (52°31’00”N; 008°16’00”E) DMA2W103 (52°27’00”N; 010°27’00”E) DMA2W104 (51°49’00”N; 010°41’00”E)	True	AAR	Scenario #05

Table 80: DMAs shape definitions, mission types and scenario allocations

[11] These characteristics are part of the DMA Type 2 description of the ARES requests logical model (except mission type).

5.4.4.1.2.1 Solution scenario #01

The Solution scenario #01 (SCN-08.01.04-VALP-1001) is focusing on DMA definition based on the optimised configuration of reference ARES while fully responding to military mission requirements:

- DMA designed using initial volumes of TRA 302 (WESER 2) described below in Figure 48;
- Use of automated tool for optimisation of the DMA location(s);
- Reference configuration and DAC reference configuration for MUAC ACCs;
- Cloned reference traffic.

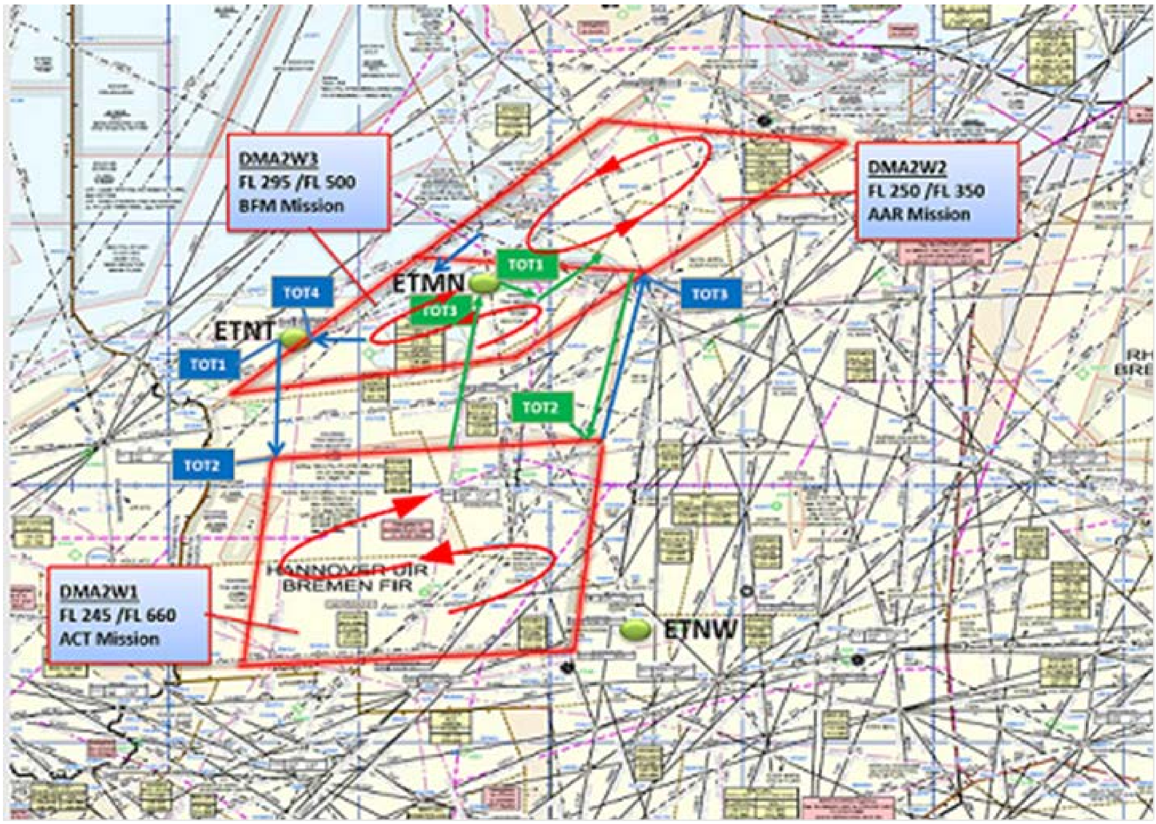


Figure 48: Definition of DMAs and use by military users in Solution scenario #01

The scenario is composed of two “sortie”; Alpha formation (blue) and Bravo formation (green):

- Route blue: ETNT – Entry DMA2W1 – Exit DMA2W1 – Entry DMA2W2 – Exit DMA2W2 – Entry DMA2W3 – Exit DMA2W3 – ETNT;
- Route green: ETMN – Entry DMA2W3 – Exit DMA2W3 – Entry DMA2W2 – Exit DMA2W2 – Entry DMA2W1 – Exit DMA2W1 – ETMN.

The associated Mission Trajectories are described in Table 81[12].

MT	ADEP	Time at 1st DMA	DMA List		Aircraft Type	# of Aircraft	ADES
			Identifier	Time Span			
MT1	ETNT	14:00	DMA2W1	60 minutes	fighters	4	ETNT
			DMA2W2	40 minutes			
			DMA2W3	40 minutes			
MT2	ETNW	15:00	DMA2W2	80 minutes	tanker	1	ETNW
MT3	ETMN	15:00	DMA2W3	40 minutes	fighters	4	ETMN
			DMA2W2	40 minutes			
			DMA2W1	60 minutes			

Table 81: MTs defined for Solution scenario #01

The activation periods of the DMAs are provided in the Tables below.

DMA	Min FL	Max FL	Start	End	Mission
DMA2W1	245	660	14:00	15:00	Alpha formation (ACT)
DMA2W2	250	350	15:00	16:20	Alpha formation 1 tanker ETNW (AAR)
DMA2W2					Bravo formation 1 tanker ETNW (AAR)
DMA2W3	295	500	15:00	16:20	Alpha formation (BFM)
DMA2W3					Bravo formation (BFM)
DMA2W1	245	660	16:20	17:20	Bravo formation (ACT)

Table 82: DMA description for Solution scenario #01

[12] These parameters are used in R-NEST tool for creating the MTs.

The timeline for the scenario is described in the figure below.

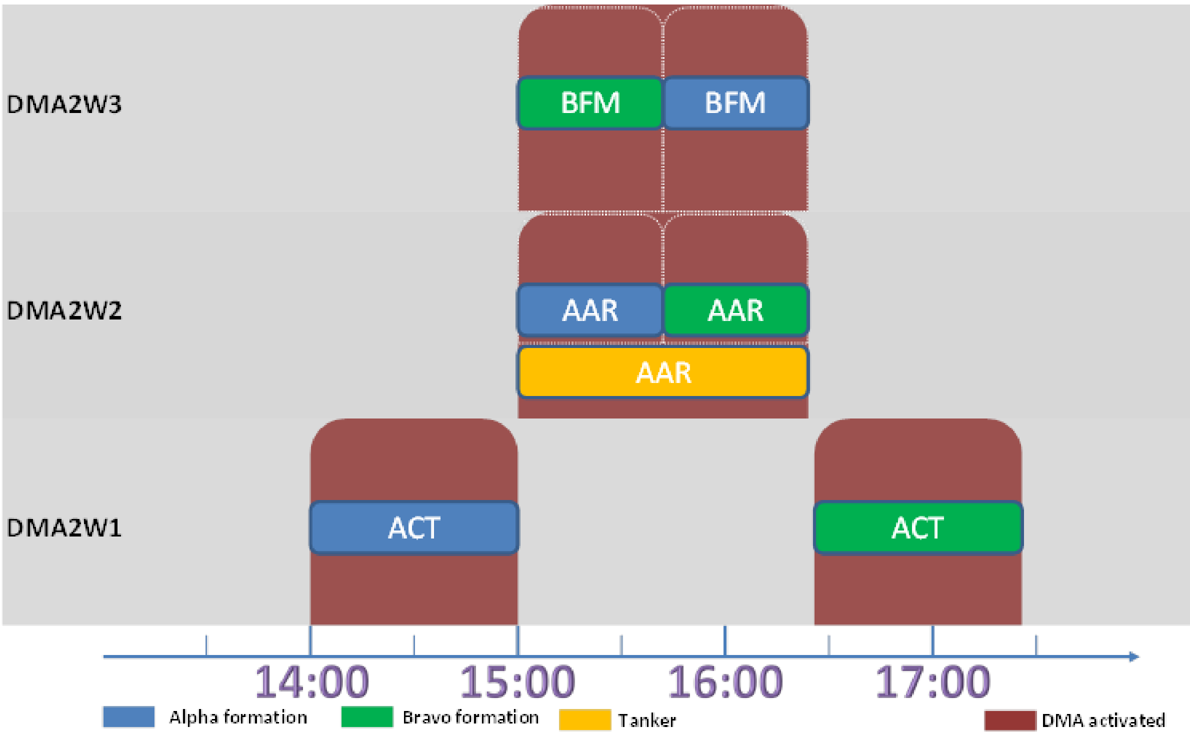


Figure 49: Timeline for Solution scenario #01

The properties defined for the automated location process are presented in the table below.

DMA	Reference Point	Maximum Distance	Time Flexibility[13]	FL Flexibility[14]
DMA2W1	ETNT	60 NM	±5 minutes	none
	ETMN	60 NM	±5 minutes	none
DMA2W2	DMA2W1	30 NM	±2 minutes	±5000 ft
DMA2W3	DMA2W2	0 NM	±5 minutes	±5000 ft

Table 83: Definition of the DMA negotiable parameters for scenario #01

[13] Flexibility on time is only applied on the starting time.

[14] Flexibility on flight levels can be applied on minimal, maximal or both level(s).

The various runs proposed for the Solution scenario #01 are described in the Table below:

Run	Description	Comment
01	DMAs using initial ARES volumes on Reference configuration (i.e. current sectorisation). Evaluation of the BTs modifications not constrained.	Safety buffer: None Intermediate points not kept. Compared to SCN-08.01.04-VALP-0001
02	DMAs using initial ARES volumes on DAC reference configuration (i.e. sectorisation generated by DAC). Evaluation of the BTs modifications not constrained.	Safety buffer: None Intermediate points not kept. Compared to SCN-08.01.04-VALP-0002
03	Optimised DMA locations on Reference configuration (i.e. current sectorisation). Evaluation of the BTs modifications not constrained.	Safety buffer: None Intermediate points not kept. DMA flexibility refer to Table 83 Compared to SCN-08.01.04-VALP-0001
04	Optimised DMA locations on DAC reference configuration (i.e. sectorisation generated by DAC). Evaluation of the BTs modifications not constrained.	Safety buffer: None Intermediate points not kept. DMA flexibility refer to Table 83 Compared to SCN-08.01.04-VALP-0002

Table 84: Solution scenario #01 runs

5.4.4.1.2.2 Solution scenario #02

The Solution scenario #02 (SCN-08.01.04-VALP-1011) is focusing on DAC process to evaluate configuration optimisation to the modified traffic sample generated in Solution scenario SCN-08.01.04-VALP-1001.

Run	Description	Comment
01	New sector configuration & opening scheme for DAC-level 2 in EDYYDUTA using modified BTs traffic for initial location of DMAs generated by SCN-08.01.04-VALP-1001.	Min/Max DFL: FL250 – FL500 DFL Layers cuts options: 245 335 345 355 505 Vertical SAMs: FL335 – FL345, FL345–FL355
02	New sector configuration & opening scheme for DAC-level 2 in EDYYDUTA using modified BTs traffic for optimised location of DMAs generated by SCN-08.01.04-VALP-1001.	Min/Max DFL: FL250 – FL500 DFL Layers cuts options: 245 335 345 355 505 Vertical SAMs: FL335 – FL345, FL345–FL355

Run	Description	Comment
03	New sector configuration & opening scheme for DAC-level 2 in EDYYHUTA using modified BTs traffic for initial location of DMAs generated by SCN-08.01.04-VALP-1001.	Min/Max DFL: FL250 – FL500 DFL Layers cuts options: 245 335 345 355 505 Vertical SAMs: FL335 – FL345, FL345–FL355
04	New sector configuration & opening scheme for DAC-level 2 in EDYYHUTA using modified BTs traffic for optimised location of DMAs generated by SCN-08.01.04-VALP-1001.	Min/Max DFL: FL250 – FL500 DFL Layers cuts options: 245 335 345 355 505 Vertical SAMs: FL335 – FL345, FL345–FL355

Table 85: Solution scenario #02 runs

5.4.4.1.2.3 Solution scenario #03

The Solution scenario #03 (SCN-08.01.04-VALP-1003) is focusing on DMA definition to fulfil military mission requirements by taking into account:

- DMA design initially defined by WOC described below in Figure 50;
- Use of automated tool for optimisation of the DMA location(s);
- Reference configuration and DAC reference configuration for MUAC ACCs;
- Cloned reference traffic.

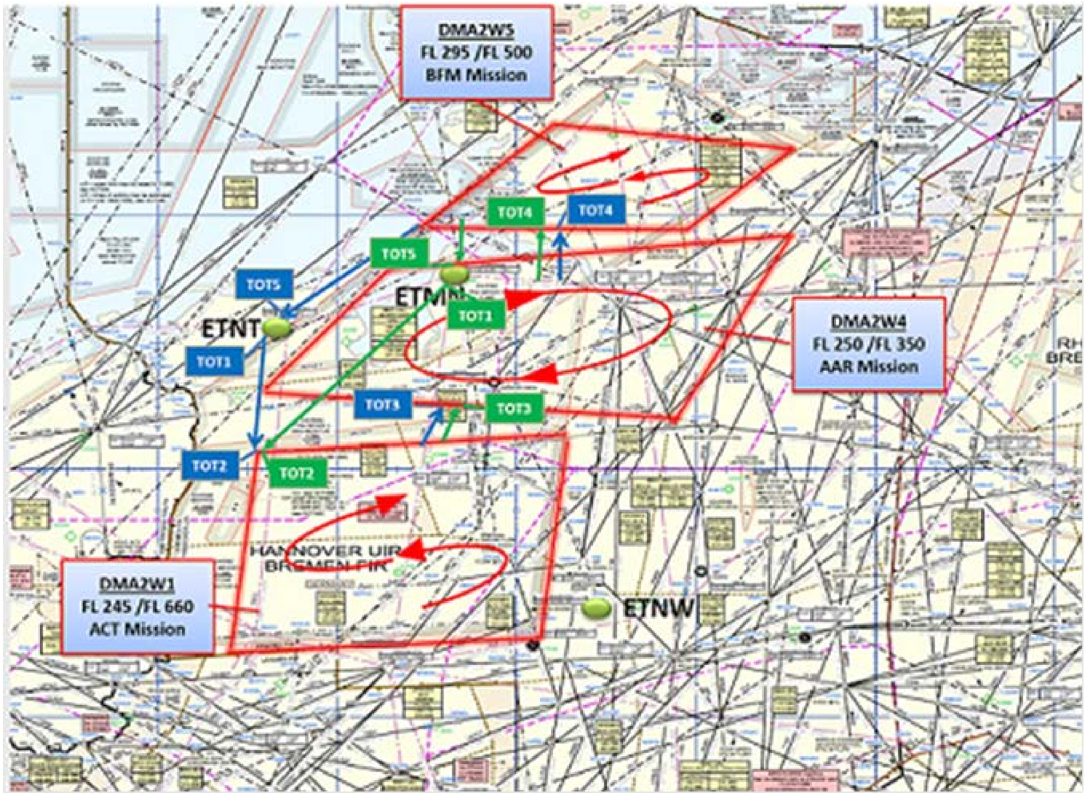


Figure 50: Definition of DMAs and use by military users in Solution scenario #03

The scenario is composed of two "sorties"; Alpha formation (blue) and Bravo formation (green):

- Route blue: ETNT – Entry DMA2W1 – Exit DMA2W1 – Entry DMA2W4– Exit DMA2W4 – Entry DMA2W5 – Exit DMA2W5 – ETNT;
- Route green: ETMN – Entry DMA2W1 – Exit DMA2W1 – Entry DMA2W4 – Exit DMA2W4 – Entry DMA2W5 – Exit DMA2W5 – ETMN.

The associated Mission Trajectories are described in Table 86[12].

MT	ADEP	Time at 1st DMA	DMA List		Aircraft Type	# of Aircraft	ADES
			Identifier	Time Span			
MT1	ETNT	14:00	DMA2W1	60 minutes	fighters	4	ETNT
			DMA2W4	40 minutes			
			DMA2W5	40 minutes			
MT2	ETNW	15:00	DMA2W4	40 minutes	tanker	1	ETNW
MT3	ETMN	15:00	DMA2W1	60 minutes	fighters	4	ETMN
			DMA2W4	40 minutes			
			DMA2W5	40 minutes			
MT4	ETNW	16:00	DMA2W4	40 minutes	tanker		ETNW

Table 86: MTs defined for Solution scenario #03

The activation periods of the DMAs are provided in the Tables below.

DMA	Min FL	Max FL	Start	End	Mission
DMA2W1	245	660	14:00	16:00	Alpha formation (ACT)
DMA2W1					Bravo formation (ACT)
DMA2W4	250	350	15:00	15:40	Alpha formation 1 tanker ETNW (AAR)
DMA2W5	295	500	15:40	16:20	Alpha formation (BFM)
DMA2W4	250	350	16:00	16:40	Bravo formation 1 tanker ETNW (AAR)
DMA2W5	295	500	16:40	17:20	Bravo formation (BFM)

Table 87: DMA description for Solution scenario #03

The timeline for the scenario is described in the figure below.

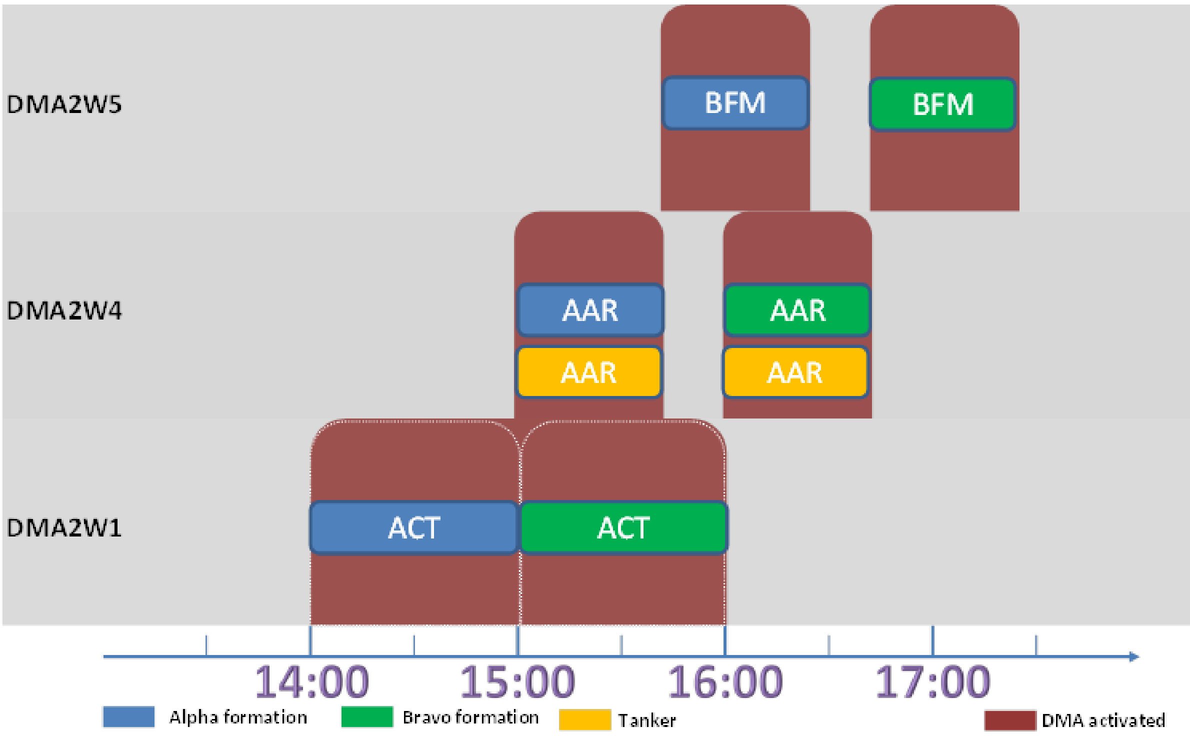


Figure 51: Timeline for Solution scenario #03

The properties defined for the automated location process are presented in the table below.

DMA	Reference Point	Maximum Distance	Time Flexibility[13]	FL Flexibility[14]
DMA2W1	ETNT	60NM	±5 minutes	none
	ETMN	60NM	±5 minutes	none
DMA2W4	No change on location	N/A	±2 minutes	±5000 ft
DMA2W5	DMA2W4	30 NM	±2 minutes	±5000 ft

Table 88: Definition of the DMA negotiable parameters for scenario #03

The various runs proposed for the Solution scenario #03 are described in the Table below.

Run	Description	Comment
01	DMAs using initial ARES volumes on Reference configuration (i.e. current sectorisation). Evaluation of the BTs modifications not constrained.	Safety buffer: None Intermediate points not kept. Compared to SCN-08.01.04-VALP-0001

Run	Description	Comment
02	DMAs using initial ARES volumes on DAC reference configuration (i.e. sectorisation generated by DAC). Evaluation of the BTs modifications not constrained.	Safety buffer: None Intermediate points not kept. Compared to SCN-08.01.04-VALP-0002
03	Optimised DMA locations on Reference configuration (i.e. current sectorisation). Evaluation of the BTs modifications not constrained.	Safety buffer: None Intermediate points not kept. DMA flexibility refer to Table 88 Compared to SCN-08.01.04-VALP-0001
04	Optimised DMA locations on DAC reference configuration (i.e. sectorisation generated by DAC). Evaluation of the BTs modifications not constrained.	Safety buffer: None Intermediate points not kept. DMA flexibility refer to Table 88 Compared to SCN-08.01.04-VALP-0002

Table 89: Solution scenario #03 runs

5.4.4.1.2.4 Solution scenario #04

The Solution scenario #04 (SCN-08.01.04-VALP-1012) is focusing on DAC process to evaluate configuration optimisation to the modified traffic sample generated in Solution scenario SCN-08.01.04-VALP-1002.

Run	Description	Comment
01	New sector configuration & opening scheme for DAC-level 2 in EDYYDUTA using modified BTs traffic for initial location of DMAs generated by SCN-08.01.04-VALP-1002.	Min/Max DFL: FL250 – FL500 DFL Layers cuts options: 245 335 345 355 505 Vertical SAMs: FL335 – FL345, FL345–FL355
02	New sector configuration & opening scheme for DAC-level 2 in EDYYDUTA using modified BTs traffic for optimised location of DMAs generated by SCN-08.01.04-VALP-1002.	Min/Max DFL: FL250 – FL500 DFL Layers cuts options: 245 335 345 355 505 Vertical SAMs: FL335 – FL345, FL345–FL355
03	New sector configuration & opening scheme for DAC-level 2 in EDYYHUTA using modified BTs traffic for initial location of DMAs generated by SCN-08.01.04-VALP-1002.	Min/Max DFL: FL250 – FL500 DFL Layers cuts options: 245 335 345 355 505 Vertical SAMs: FL335 – FL345, FL345–FL355

Run	Description	Comment
04	New sector configuration & opening scheme for DAC-level 2 in EDYYHUTA using modified BTs traffic for optimised location of DMAs generated by SCN-08.01.04-VALP-1002.	Min/Max DFL: FL250 – FL500 DFL Layers cuts options: 245 335 345 355 505 Vertical SAMs: FL335 – FL345, FL345–FL355

Table 90: Solution scenario #04 runs

5.4.4.1.2.5 Solution scenario #05

The Solution scenario #05 (SCN-08.01.04-VALP-1003) is focusing on DMA definition only limited by the national airspace delegated to Germany for two “sorties”:

- DMA design initially defined by WOC and mutualised/overlap for the two “sorties” described below in Figure 52;
- Use of automated tool for optimisation of the DMA location(s);
- Reference configuration and DAC reference configuration for MUAC ACCs;
- Cloned reference traffic.

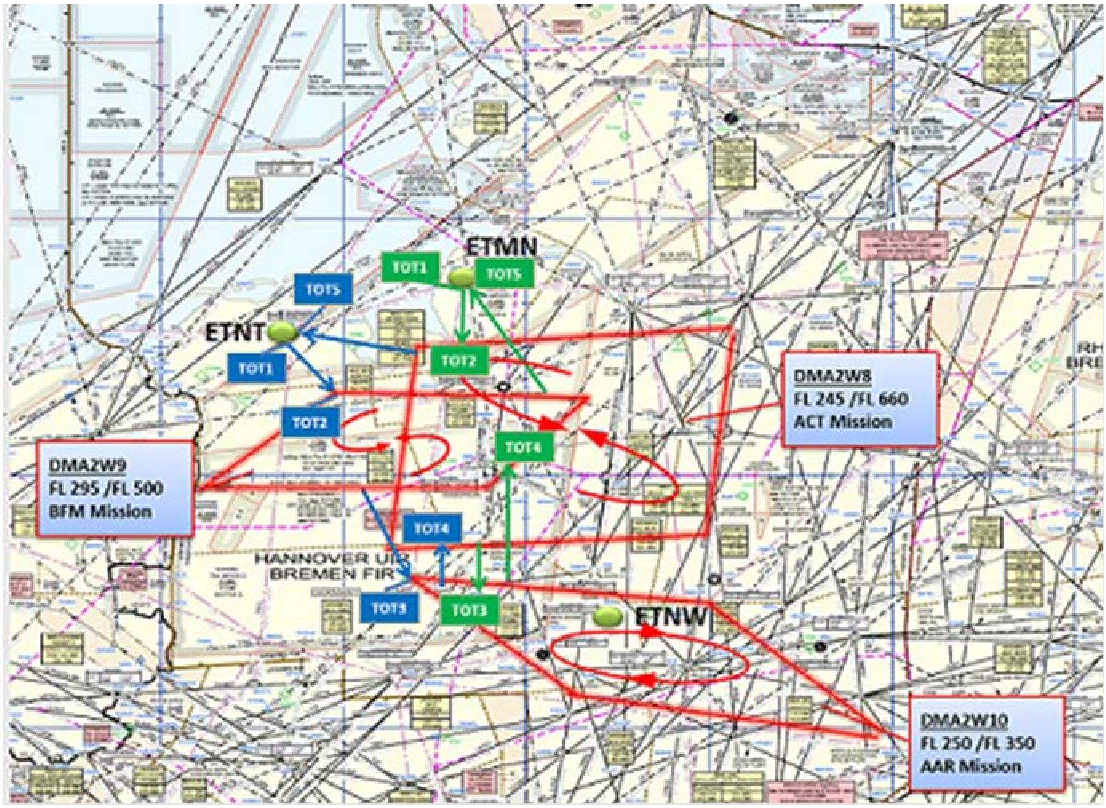


Figure 52: Definition of DMAs in Solution scenario #05

The scenario is composed of 2 “sorties”; Alpha formation (blue) and Bravo formation (green):

- Route blue: ETNT – Entry DMA2W9 – Exit DMA2W9 – Entry DMA2W10 – Exit DMA2W10 – Entry DMA2W8 – Exit DMA2W8 – ETNT;
- Route green: ETMN – Entry DMA2W8 – Exit DMA2W8 – Entry DMA2W10 – Exit DMA2W10 – Entry DMA2W9 – Exit DMA2W9 – ETMN.

The associated Mission Trajectories are described in Table 91[12].

MT	ADEP	Time at 1st DMA	DMA List		Aircraft Type	# of Aircraft	ADES
			Identifier	Time Span			
MT1	ETNT	14:00	DMA2W9	40 minutes	fighters	4	ETNT
			DMA2W10	40 minutes			
			DMA2W8	50 minutes			
MT2	ETMN	14:40	DMA2W8	50 minutes	fighters	4	ETMN
			DMA2W10	40 minutes			
			DMA2W9	40 minutes			

Table 91: MTs defined for Solution scenario #05

Note: The DMA designated for AAR is located above ETNW airfield, thus for tanker there is no specific trajectory defined for DMAW10.[15]

The activation periods of the DMAs are provided in the Table below.

DMA	Min FL	Max FL	Start	End	ADEP/ADES
DMA2W9	295	500	14:00	14:40	Alpha formation (BFM)
DMA2W10	250	350	14:40	15:20	Alpha formation 1 tanker ETNW (AAR)
DMA2W8	245	660	14:40	16:20	Alpha formation (ACT)
DMA2W8					Bravo formation (ACT)
DMA2W10	250	350	15:40	16:20	Bravo formation 1 tanker ETNW (AAR)
DMA2W9	295	500	16:20	17:00	Bravo formation (BFM)

Table 92: DMA description for Solution scenario #05

[15] Tanker is integrated into the civil traffic and is controlled by military.

The timeline for the scenario is described in the figure below.

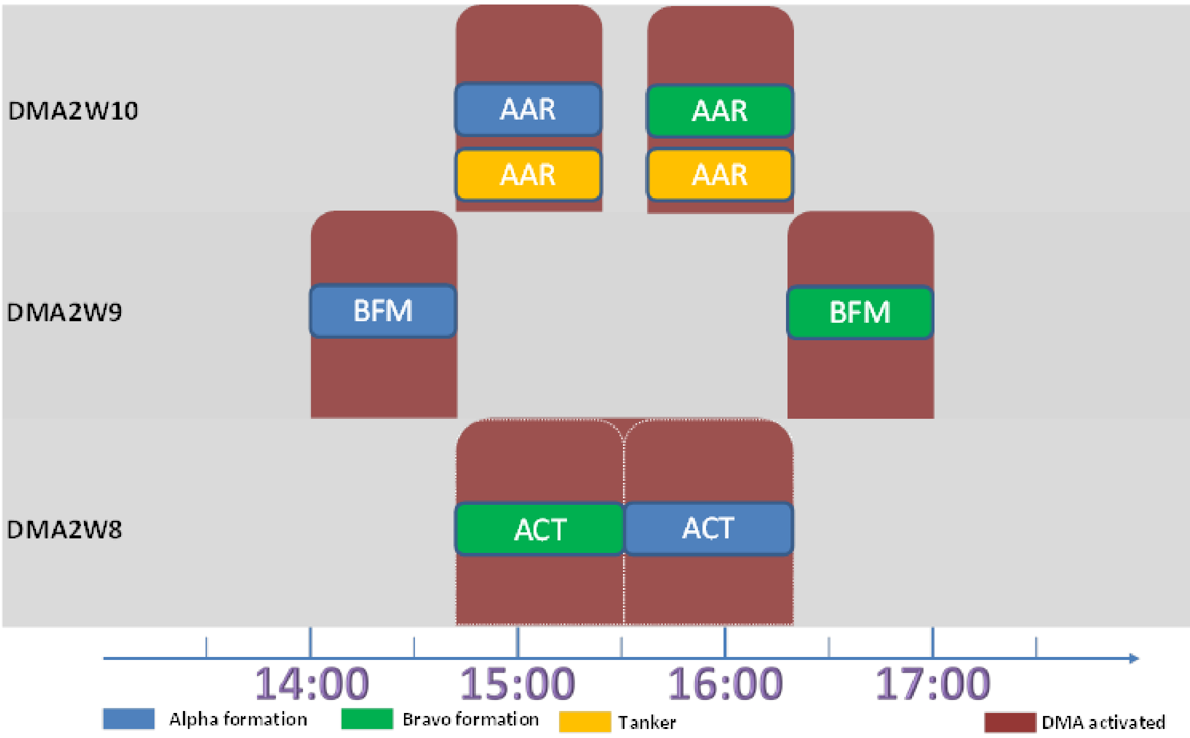


Figure 53: Timeline for Solution scenario #05

The properties defined for the automated location process are presented in the table below.

DMA	Reference Point	Maximum Distance	Time Flexibility[13]	FL Flexibility[14]
DMA2W8	No change on location	N/A	±2 minutes	None
DMA2W9	ETNT	60 NM	±1 minutes	±5000 ft
	ETMN	60 NM	None	±5000 ft
DMA2W10	No change on location	N/A	±2 minutes	±5000 ft

Table 93: Definition of the DMA negotiable parameters for scenario #05

The various runs proposed for the Solution scenario #05 are described in the Table below.

Run	Description	Comment
01	DMAs using initial ARES volumes on Reference configuration (i.e. current sectorisation). Evaluation of the BTs modifications not constrained.	Safety buffer: None Intermediate points not kept. Compared to SCN-08.01.04-VALP-0001

Run	Description	Comment
02	DMAs using initial ARES volumes on DAC reference configuration (i.e. sectorisation generated by DAC). Evaluation of the BTs modifications not constrained.	Safety buffer: None Intermediate points not kept. Compared to SCN-08.01.04-VALP-0002
03	Optimised DMA locations on Reference configuration (i.e. current sectorisation). Evaluation of the BTs modifications not constrained.	Safety buffer: None Intermediate points not kept. DMA flexibility refer to Table 93 Compared to SCN-08.01.04-VALP-0001
04	Optimised DMA locations on DAC reference configuration (i.e. sectorisation generated by DAC). Evaluation of the BTs modifications not constrained.	Safety buffer: None Intermediate points not kept. DMA flexibility refer to Table 93 Compared to SCN-08.01.04-VALP-0002

Table 94: Solution scenario #05 runs

5.4.4.1.2.6 Solution scenario #06

The Solution scenario #06 (SCN-08.01.04-VALP-1013) is focusing on DAC process to evaluate configuration optimisation to the modified traffic sample generated in Solution scenario SCN-08.01.04-VALP-1003.

Run	Description	Comment
01	New sector configuration & opening scheme for DAC-level 2 in EDYYDUTA using modified BTs traffic for initial location of DMAs generated by SCN-08.01.04-VALP-1003.	Min/Max DFL: FL250 – FL500 DFL Layers cuts options: 245 335 345 355 505 Vertical SAMs: FL335 – FL345, FL345–FL355
02	New sector configuration & opening scheme for DAC-level 2 in EDYYDUTA using modified BTs traffic for optimised location of DMAs generated by SCN-08.01.04-VALP-1003.	Min/Max DFL: FL250 – FL500 DFL Layers cuts options: 245 335 345 355 505 Vertical SAMs: FL335 – FL345, FL345–FL355
03	New sector configuration & opening scheme for DAC-level 2 in EDYYHUTA using modified BTs traffic for initial location of DMAs generated by SCN-08.01.04-VALP-1003.	Min/Max DFL: FL250 – FL500 DFL Layers cuts options: 245 335 345 355 505 Vertical SAMs: FL335 – FL345, FL345–FL355

Run	Description	Comment
04	New sector configuration & opening scheme for DAC-level 2 in EDYYHUTA using modified BTs traffic for optimised location of DMAs generated by SCN-08.01.04-VALP-1003.	Min/Max DFL: FL250 – FL500 DFL Layers cuts options: 245 335 345 355 505 Vertical SAMs: FL335 – FL345, FL345–FL355

Table 95: Solution scenario #06 runs

5.4.4.2 Scenarios for Part 2

5.4.4.2.1 Reference Scenario(s)

5.4.4.2.2 Solution Scenario(s)

5.4.5 Exercise Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
Exercise Part 1										
PJ08-Exe4-A#1	Current sectorisation is representative	Airspace Layout	MUAC area is not fully Free Route airspace. Current sectorisation is used considering it is representative even for the Free Route traffic generated	S2020 context	Planning	CAP	PJ.08-01	N/A	PJ.08-01	Medium
PJ08-A#1	Traffic flow in free route airspace	Traffic Layout	Traffic sample has been adapted to the FRA principles, as there are no FRA implemented in MUAC airspace	S2020 context	Planning	CAP SAF ENV	07.05.04 VALP [38](SESAR I)	N/A	PJ.08-01	Medium
PJ08-EXE4-A#2	National airspace	Airspace Layout	DMAs for military activities can only be located in the airspace managed by the state performing the activities.		Planning	CAP SAF ENV FEFF	PJ.08-01	N/A	PJ.08-01	Medium

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
PJ08-EXE#4-A#3	Impact from re-routing will be low for traffic in EDYYBUTA	Traffic Layout	BTs modifications due to DMA activation in German airspace will have only a low impact in the BUTA airspace.		Planning	CAP SAF ENV FEFF	PJ.08-01	N/A	PJ.08-01	Low
PJ08-EXE#4-A#4	DMA design	Airspace Layout	DMAs have been created following mission effectiveness criteria		Planning	CAP SAF ENV FEFF	PJ.08-01	N/A	PJ.08-01	Medium
PJ08-EXE#4-A#5	Initial step of CDM process completed		DMA locations proposed in the scenarios are supposed to be a first consensus build on a CDM negotiation prior to D_{ops}-3.		Planning		PJ.08-01	N/A	PJ.08-01	Low

Table 96: Validation Exercise EXE-08.01-V2-VALP-004 Assumptions

5.4.6 Limitations and impact on the level of Significance

The structure of the exercise is inducing some limitations and impacts on the validation. For Part 1 those limitations are summarised below:

- No Free Route traffic available for MUAC airspace;
- VPA concept not supported;
- DMA are available in Free Route Airspace only;
- No reshape of areas, except flight levels, proposed by the allocation tool;
- BTs modifications process is limited to the Free Route Airspace part of the trajectory;
- No cross-border location considered/authorised.

5.4.6.1 No Free Route Traffic

Currently MUAC airspace is not a Free route Airspace, thus there is no live data available to feed the exercise.

In order to follow-up onthe work done in SESAR I (airspace design for SBBs & SAMs), the traffic used in this exercise is that defined in exercise EXE-07.05.04-VP-718 (from SESAR I P07.05.04) for MUAC airspace (Part A) [38].

The traffic has been generated by Lido[16] and Sabre[17] systems and used with a 2014 environment in EXE-07.05.04-VP-718 [38]. To have a current s network environment reference, the traffic has been imported into a 2017 environment (i.e. AIRAC 1706-426).

Furthermore the cloning of the traffic based on STATFOR growth might not be completely representative as this traffic has been generated.

This means that the reference scenario is not completely reflecting the current operational situation. This limits the significance of the absolute quantitative values obtained and it should be kept in mind that results have to be carefully analysed considering potential evolution from the reference (i.e. Comparison with the reference) and not for providing absolute figures.

5.4.6.2 VPA concept not supported

The reference of the exercise is the operations as provided by SESAR I implementation. In this context VPA could be used however the tool is not supporting this kind of area.

This will not have a direct impact on the relevance of the exercise results.

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[16] Lido: Lufthansa Systems flights planning tool

[17] Sabre: Sabre Airlines Solutions, flight planning tool

5.4.6.3 DMA restricted to Free Route Airspace

The DMA has to be located inside a Free Route Airspace, meaning that DMA cannot be defined using low flight levels (i.e. below FL 245) or be partially contained in the Free Route Airspace. Thus some mission types (e.g. air/ground attack) cannot be addressed or currently used levels restricted.

This will not have a direct impact on the exercise which is mainly targeting En-Route impacts.

5.4.6.4 No reshape of areas

The automated tool providing the best location for a DMA is considering only evolution of the vertical (i.e. Flights Levels) and time (i.e. activation period) dimensions. The 2D shape (i.e. surface of the volume is not changed in order to adapt to the traffic demand pattern.

This will not have a direct impact on the relevance of the exercise results as the initial shape has been designed to fulfil the military request for the specific mission.

5.4.6.5 BTs modifications limited to the Free Route Airspace volume

The tool is restricting the BTs modifications process to the Free Route Airspace (i.e. starts at the entry of the airspace), the constraint applied to BTs modifications is to keep the same entry and exit points as the Free Route Airspace. This prevents the BTs modifications mechanism to completely avoid the Free Route Airspace even if it is the optimal option.

As the exercise is not aiming at evaluating impact at a network level but only at local level, this is not having a direct impact on the relevance of the exercise results.

5.4.6.6 No cross-border location authorised

Imposing the location of the DMA into the national and delegated airspace of Germany (refer to §5.4.5) might lead to the selection of a less optimal location with regard to the traffic pattern, especially when the area is close to the state border.

5.4.7 Validation Exercise Platform / Tool and Validation Technique

The tools involved in the validation exercise are:

- **R-NEST** (Research Network Strategic Tool): R-NEST is a model-based simulation tool, sharing the same base as the EUROCONTROL NEST tool. R-NEST is EUROCONTROL integrated validation tool combining advanced dynamic ATFCM capabilities with powerful airspace design and capacity planning analysis functionalities. It offers powerful scenario-based modelling engine to simulate ATM network operations, detect and observe various types of delays, identify and dynamically resolve demand vs capacity imbalances over the network, use concepts such as STAM, create dynamic airspace sectorisation using new algorithms and measure performance improvements of new ATM concepts on a network level. The ICO analyser is part of R-NEST and allows optimising the ACC configuration opening scheme to balance controller usage with overloads using a customizable optimisation strategy. The ICO analyser displays the opening scheme and corresponding controller usage and overload indicators before and after applying the optimisation strategy.

For the scope of PJ.08-01 validation exercises, enhancements have been performed:

- Integration of SAGA/COBOS algorithms;
- Extent of ICO analyser design and analysis functionalities to sector configurations composed of DAC elements (SBBs and SAMs) to allow more dynamicity of the ACC configuration opening scheme;
- What if function for DMA has been developed that enable to assess the impact of DMA location on the civil trajectories;
- Automated location tool for DMA;
- Mission Trajectory (MT) implementation (initial backbone structure);
- Integration of BADA for fuel consumption evaluation.

- **AirTOp** (Air Traffic Optimization) is a fast time simulator developed by AirTOpSoft Company. It is an event driven simulator that navigates each flight along its calculated 4D trajectory. Main features provided by the tool allow modelling of individual actors (e.g. Tactical and Planning Controllers, FMPs, NM), Tasks/Workload, Time Constraint (TC) and airport. Furthermore conflict detection & resolution, AMAN pre-sequencing and TMA Vectoring are also provided as well as an atmospheric model. Specific features for the validation of Network Management Concept and Advanced Airspace Management are also available:
  - Traffic occupancy, Entry Load and Delay Monitoring;
  - Constant Occupancy Count;
  - Flights Exemption;
  - DCB Measures and negotiation process;
  - Speed adjustment;
  - Fuel Consumption;
  - BADA 4 Integration;
  - Most Penalising Constraint (MPC);
  - Free Route;
  - Dynamic Airspace Configuration;
  - Virtual Profile Area (VPA);
  - Mission Trajectory (RMT);
  - Automatic alternate routes.

5.4.7.1 Validation Exercise Platform/Tool characteristics

V&V Platform Name		**EUROCONTROL: R-NEST modelling platform**
A.1.1	It is a new developed V&V platform?	NO With respect to SESAR I, the integration of COBOS , SAGA and DMA support consists of a large extension of the R-NEST capabilities
A.1.2	If yes, which are the reasons supporting the development of a new platform?	Not applicable
A.2	It is the first time to be used for a SESAR validation exercise	NO It has been already used during SESAR I validation sessions and has also been used by VP-08.01-01.
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	NO As mentioned above the platform has been customised for VP-08.01-04. Some specific adaptations (e.g. Dynamic Mobile Area (DMA), Mission Trajectory (MT)) have been done for enhancing the capabilities of the tool.
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	Dynamic Mobile Area Type 2 (DMA Type 2) and Mission Trajectory (MT).
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	Performance assessment of DMA Type 2 and evaluation of MT.
D	Which validation methods can be used on the new V&V Platform?	R-NEST is a modelling platform.
V&V Platform Name		**EUROCONTROL: AirTOp FTS platform**
A.1.1	It is a new developed V&V platform?	NO AirTOp (Air Traffic Optimization) is an open and modular fast-time simulation platform with a Network/ATFCM module for concept investigation and performance studies. The platform allows the measurement of the Key Performance Indicators (KPIs) for most of Key Performance Areas (KPAs) - e.g. Capacity, Cost Effectiveness, Efficiency, Environment, Safety.
A.1.2	If yes, which are the reasons supporting the development of a new platform?	Not applicable
A.2	It is the first time to be used for a SESAR validation exercise	
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	

V&V Platform Name		EUROCONTROL: R-NEST modelling platform
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	
D	Which validation methods can be used on the new V&V Platform?	Fast Time Simulation.

Table 97: Validation Exercise EXE-08.01-V2-VALP-004 Platform/Tool characteristics

5.4.7.2 Architectural view: mapping Validation Infrastructure and SUTs onto EATMA

V&V Platform Name		EUROCONTROL: R-NEST modelling platform
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	ASM ATFCM
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	Cooperative Airspace Management Cooperative Scenario Planning
V&V Platform Name		**EUROCONTROL: AirTOp FTS platform**
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	

Table 98: Validation Exercise EXE-08.01-V2-VALP-004 Platform / Tool mapping onto EATMA

5.4.7.3 Validation Exercise Technique

The selected validation technique for Part 1 is modelling using the R-NEST platform. R-NEST is a EUROCONTROL integrated validation tool combining advanced dynamic ATFCM capabilities with powerful airspace design and capacity planning analysis functionalities. R-NEST offers powerful scenario-based modelling engine to simulate ATM network operations, create dynamic airspace sectorisation using new algorithms and measure performance improvements of new ATM concepts on a network and local levels.

Modelling is an appropriate technique for the primary validation/assessment of performances of the DMA Type 2 concept, even if the targeted maturity level is V2. This technique allows collecting qualitative and quantitative data results.

This validation technique has been considered the most suitable to address validation objectives for EXE-08.01-V2-VALP-004 exercise Part 1.

Contribution to targeted maturity level V2 is addressed by Part 2. The selected validation technique is here Fast Time Simulation using AirTOp platform. AirTop is an industrial tool customised for SESAR validation activities, a dedicated Network/ATFCM module has been developed for concept investigation and performance studies.

This validation technique has been considered the most suitable to address validation objectives for EXE-08.01-V2-VALP-004 exercise Part 2 and preparation of EXE-08.01-V2-VALP-002 exercise.

5.4.8 Analysis Specification

5.4.8.1 Data collection methods

This following table provides an overview of the data collection methods which will be used to obtain the relevant data for analysis following the execution of the runs. This will include both quantitative data in the form of recorded metrics which will be obtained from the R-NEST tool after each exercise and qualitative data which will be derived through subjective feedback obtained from the user in the form of structured questionnaires, debriefings and general observations.

Exercise Validation Objective	METRICS/KPI	Data collection method	
		Part 1	Part 2
EX4-OBJ-08.01-V2-VALP-PE1-001	**CAP2**: En-route throughput per unit time Unit: Relative change of movements (% and number of movement). Calculation: number of movements per volume airspace per hour (occupancy counts).	**Quantitative output from R-NEST**	
EX4-OBJ-08.1-V2-VALP-PE1-003	**CEF2**: Flights per ATCO-Hour on duty Unit: Nb Calculation: Count of Flights handled divided by the number of ATCO-Hours applied by ATCOs on duty.	**Quantitative output from R-NEST**	
EX4-OBJ-08.01-V2-VALP-PE1-004	**SAFETY** : N° of conflicting SBT/RBTs in reference and solutions scenarios Unit: Nb of conflicts Calculation: Variation in SBT/RBT crossing linked to BTs modifications of civil flights and civil/military flights.	**Quantitative output from R-NEST**	

Exercise Validation Objective	METRICS/KPI	Data collection method	
		Part 1	Part 2
EX4-OBJ-08.01-V2-VALP-PE1-005	**FEFF1.1**: Planned Average fuel burn per flight Unit: Kg fuel per movement Calculation: Total amount of fuel burn divided by the number of movements.	**Quantitative output from R-NEST**	
	FEFF2: CO2 Emissions Unit: Kg CO2 per movement Calculation: Amount of fuel burn x 3.15 (CO2 emission index) divided by the number of movements.	**Quantitative output from R-NEST**	
	FEEF3: Reduction in average flight duration Unit: Minutes Calculation: Average actual flight duration measured in the Reference Scenario – Average flight duration measured in the Solution Scenario.	**Quantitative output from R-NEST**	
EX4-OBJ-08.01-V2-VALP-PE1-006	**CMC1.3** : Transit Time to/from airbase to ARES Unit: Minutes Calculation: Total airborne time outside DMA(s) (based on mid-speed).	**Quantitative output from R-NEST**	
	CMC1.3-1: time spent in DMA(s) versus total mission time Unit: % Calculation: Ratio between times spent in DMA(s) versus total mission time (based on mid-speed).	**Quantitative output from R-NEST**	
EX4-OBJ-08.01-V2-VALP-TF1-002	Automated Tools Operator feedback on DAC and DMAs design Identification of research prototype further requirements needs, if any.	**Questionnaires and expert judgement**	
EX4-OBJ-08.01-V2-VALP-TF1-003	Monitoring Tools Operator feedback on DAC configuration optimiser/monitoring Identification of research prototype further requirements needs, if any	**Questionnaires and expert judgement**	
EXE4-OBJ-08.01-V2-VALP-OF1-003	Operator feedback on DMA location automated tool acceptability. Identification of research prototype further requirements needs, if any	**Questionnaires and expert judgement**	

Exercise Validation Objective	METRICS/KPI	Data collection method	
		Part 1	Part 2
EX4-OBJ-08.01-V2-VALP-CO1-001	The same indicators of EX4-OBJ-08.01-V2-VALP-PE1 calculated for the Free Route Scenario	**Quantitative output from R-Nest**	
	N° Flight modified Unit: Nb Calculation: N° Flight modified due to DMA	**Quantitative output from R-NEST**	
	Route length extension Unit: Nautical miles Calculation: Nautical miles flown of aircraft which circumnavigate a DMA	**Quantitative output from R-NEST**	
	N° of conflicting SBT/RBTs in reference and solutions scenarios Unit: Nb Calculation: Variation in SBT/RBT crossing linked to BTs modifications of civil flights and civil/military flights.	**Quantitative output from R-NEST**	
	Traffic density Unit: Nb Calculation: Traffic Density for a given sector is the sum of the time spent by each aircraft in the sector divided by a selected time period	**Quantitative output from R-NEST**	
EX4-OBJ-08.01-V2-VALP-CO1-003	Operator feedback on DMA design and automated location are compatible with Mission Trajectory management principles.	**Questionnaires and expert judgement**	

Table 99: Metrics and Indicators defined for Validation Exercise EXE-08.01-V2-VALP-004

5.4.8.2 Analysis method

The metrics described in Table 99 above will be collected by system recordings and output in terms of quantitative data will be recorded and logged in R-NEST during the exercises and on completion of the exercises, will be delivered in a format that can be used for further analysis. The qualitative data provided will be analysed by operational experts to complement the assessment and analysis of the final results of the exercise.

5.4.9 Exercise Planning and management

5.4.9.1 Activities

The activities performed during the exercise can be divided into three main categories:

- Preparatory activities;
- Execution activities;

- Post-execution activities.

5.4.9.1.1 Preparatory activities

The main tasks associated to Part 1 are described hereafter:

- High-level exercise definition (EXE#04-Pre-01): From the validation strategy developed for PJ.08, selection and refinement of the validation objectives, success criteria and indicators allocated to the specific exercise;
- Scenario definition (EXE#04-Pre-02): This encompasses the environment selection & definition (i.e. airspace configuration), the traffic preparation (including selection & adaptation[18] of civil traffic & definition of military traffic);
- Exercise Plan production (EXE#04-Pre-03): This is the production of dedicated plan for further incorporation to the PJ.08 VALP;
- Platform preparation (EXE#04-Pre-04): Setting of the validation platform (R-NEST) including needed evolution(s) and data-logging checking. "in-situ" dry-runs[19] will be carried out in order to confirm methodology, procedures, platform and scenarios are correctly working. Deviations and failures, if any, should be investigated and corrective actions taken prior to the execution run.
- Integration of Exercise Plan in the PJ.08 Validation Plan (EXE#04-Pre-05): The plan is consolidated in the Solution 01 Validation Plan.

5.4.9.1.2 Execution activities

The foreseen execution activities for Part 1 are described below:

- Run Session 1 (EXE#04-Exe-01):
  - Execution of Reference scenario #01 Part 1;
  - Execution of Reference scenario #02 Part 1;
  - Execution of Solution scenario #01 Part 1;
  - Execution of Solution scenario #03 Part 1;
  - Execution of Solution scenario #05 Part 1.
- Run Session 2 (EXE#04-Exe-02):
  - Execution of Solution scenario #02 Part 1;
  - Execution of Solution scenario #04 Part 1;
  - Execution of Solution scenario #06 Part 1.

[18] Mainly cloning traffic to 2035 expectation [40].

[19] A dry-run session is foreseen prior to each exercise run session.

5.4.9.1.3 Post-Execution activities

The main activities are reported below:

- Data analysis (EXE#04-Post-01): The purpose is to carry out the analysis of the results in accordance with the validation exercise plan;
- Exercise Report production (EXE#04-Post-02): From the outputs of the analysis, report synthetize the validation results for further incorporation to the PJ.08 Validation Report;
- Integration of Exercise Report in the PJ.08 Validation Report (EXE#04-Post-03): The exercise results are consolidated in the Solution 01 Validation Report.

5.4.9.2 Roles & Responsibilities in the exercise

Exercise EXE-08.01-V2-VALP-004 is being led by EUROCONTROL who is responsible for the definition, coordination execution and analysis of the exercise.

Airbus and NATS will contribute to the definition of scenarios and participate in the exercise results analysis.

The main tasks are outlined as follows:

- Definition of the validation activities for the exercise as described in PJ-08 OSED (EUROCONTROL);
- Production of the exercise plan (EUROCONTROL, Airbus & NATS);
- Integration of Exercise Plan in the Validation Plan (EUROCONTROL);
- Design of the validation exercise (EUROCONTROL, Airbus & NATS);
- Setting up of simulation tool for modelling (EUROCONTROL);
- Planning and conduct of the validation exercise (EUROCONTROL);
- Analysis of the exercise results (EUROCONTROL, Airbus & NATS);
- Production of the exercise report (EUROCONTROL, Airbus & NATS);
- Integration of the exercise results and conclusions in the Validation Report (EUROCONTROL).

The roles and responsibilities of the staff involved in the exercise have been identified as follows:

Project leader: Ensures that the exercise phases are in line with the project management plan and all major deliverables are provided in a timely manner.

Solution leader: Responsible for ensuring coherency and consistency of the framework of the exercise with the concept as described in the OSED.

Exercise coordinator: In charge of the preparation and planning of the exercise, including coordination with the relevant stakeholders/experts and consolidation/consistency checks of the inputs. He/she is responsible of the consolidation and production of the exercise plan and exercise report.

Validation expert: Responsible for the definition of the exercise, integration of the exercise plan in the validation plan, analysis of results and integration of exercise report into the validation report.

Technical expert: Responsible for the technical aspects of the exercise, ensuring workability of the platform and tools in both preparation and execution phases.

Operational expert: Responsible for the operational definition and design of the scenarios, supporting validation expert during analysis of the results and collaborate to the production of the exercise plan and exercise report.

5.4.9.3 Time planning

5.4.9.3.1 Time planning for Part 1

Activity	Month							
	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018
EXE#04-Pre-01								
EXE#04-Pre-02								
EXE#04-Pre-03								
EXE#04-Pre-04								
EXE#04-Pre-05								
EXE#04-Exe-01								
EXE#04-Exe-02								
EXE#04-Post-01								
EXE#04-Post-02								
EXE#04-Post-03								

Table 100: Detailed time planning for Validation Exercise EXE-08.01-V2-VALP-004 Part 1

5.4.9.3.2 Time planning for Part 2

[…]

Activity	Month					
	1	2	3	4	…	n

Table 101: Detailed time planning for Validation Exercise #04 Part 2

5.4.9.4 Identified Risks and mitigation actions

Some risks have been identified for the various activities that compose the exercise. These risks are summarised in Table below along with proposed mitigation actions.

Risks	Impact	Probability	Mitigation Actions
Risk #01: Limitations of the validation tool on the level of significance of the results.	3-Medium	2-Low	Production of specific document for technical requirements. Monthly coordination with development team (ad-hoc meeting if needed). Request for intermediate/beta release to evaluate/pre-validate evolutions and/or work-arounds.
Risk #02: Delay in delivery of specific developments.	3-High	3-Medium	Monthly coordination with development team (ad-hoc meeting if needed).

Table 102: Risks and mitigation actions for Validation Exercise #04

5.5 Validation EXE-08.01-V2-VALP-005 Plan

This validation exercise plan has been developed under the scope of VP-08-01-V2-VALP-005 "DAC integrated in a flow-centric approach, in preparation for integration with INAP WP ".

5.5.1 Validation Exercise description and scope

EXE-08.01-V2-VALP-005 is a validation exercise planned within the framework of PJ08 solution 01 to contribute to reach the PJ08 V2 maturity level.

The EXE-08.01-V2-VALP-005 aims to contribute to:

- A performance assessment of DAC using metrics for the DAC process (predictability, cost efficiency, safety),
- The operational feasibility of using a decision support tool for the optimization of sector configurations throughout the day, focusing on FMPs and Supervisors (through tools requirements, usability, human capability, operational procedures, and acceptability).

EXE-08.01-V2-VALP-005 is led by DSNA, including linked third parties ENAC and ONERA. The exercise is divided into two subparts:

1. . The optimization of sectors configuration and direct routings, using SAM in pre-tactical phase
2. The development of a DAC decision support tool for FMP (LTM), EAP and Supervisors.

5.5.1.1 Optimizing sectors configuration and direct routings, using SAM in pre-tactical phase

This first subpart addresses the development of algorithms to find, at pre-tactical level (D-1), optimal airspace configuration sequence for a given period (the whole day) – optimal opening scheme, using the "horizontal SAM" concept, and seeking to maximize the use of direct routings.

The aim of this subpart focuses on improvement of the ATM system performance:

- cost-effectiveness due to optimal number of active sectors and maximization of the controllers load;

- En-route fuel efficiency and environment due to reduced flown distance;
- and predictability due to planning of the direct routes in pre-tactical level rather than tactical one (in-flight).

It also aims to improve the load distribution among the active controllers with a more balanced-equitable load.

In other words, considering a given traffic demand, sector and direct route opening scheme should:

- 'minimize' number of open sectors;
- 'maximize' published direct routes;
- and provide best overall load balance,

while respecting sector capacities and cross flows constraints, complying eligible transitions between sector configurations and conforming with other operational constraints.

5.5.1.1.1 General description of the first subpart

This exercise is carried out in the East cluster of Aix ACC[20] with predominant traffic flows going from North to South and vice versa. This simulation exercise is based on the traffic from the week 20 of 2017 (from the 15th to 20th of May 2017). Eurocontrol's Demand Data Repository 2 (DDR2) was the source of the historical traffic data. In the simulation nominal sector's capacities (capacities without adverse conditions nor activation of TSA) expressed in terms of entry counts are used.

The preparatory activities of the exercise contained several steps described hereafter:

1. The definition[21] of direct routes for North-South and South-North traffic flows that minimize flown distance, respect existing route and airspace structure, and optimize flow crossings. Figure 54 shows existing ATS routes (red color) and proposal of the corresponding direct routes (green color) for both North-South (Figure 1a) and South-North (Figure 1b) traffic flows. It should be noted that the new direct route crosses existing TSA therefore their availability is linked with activation of the restricted military area.

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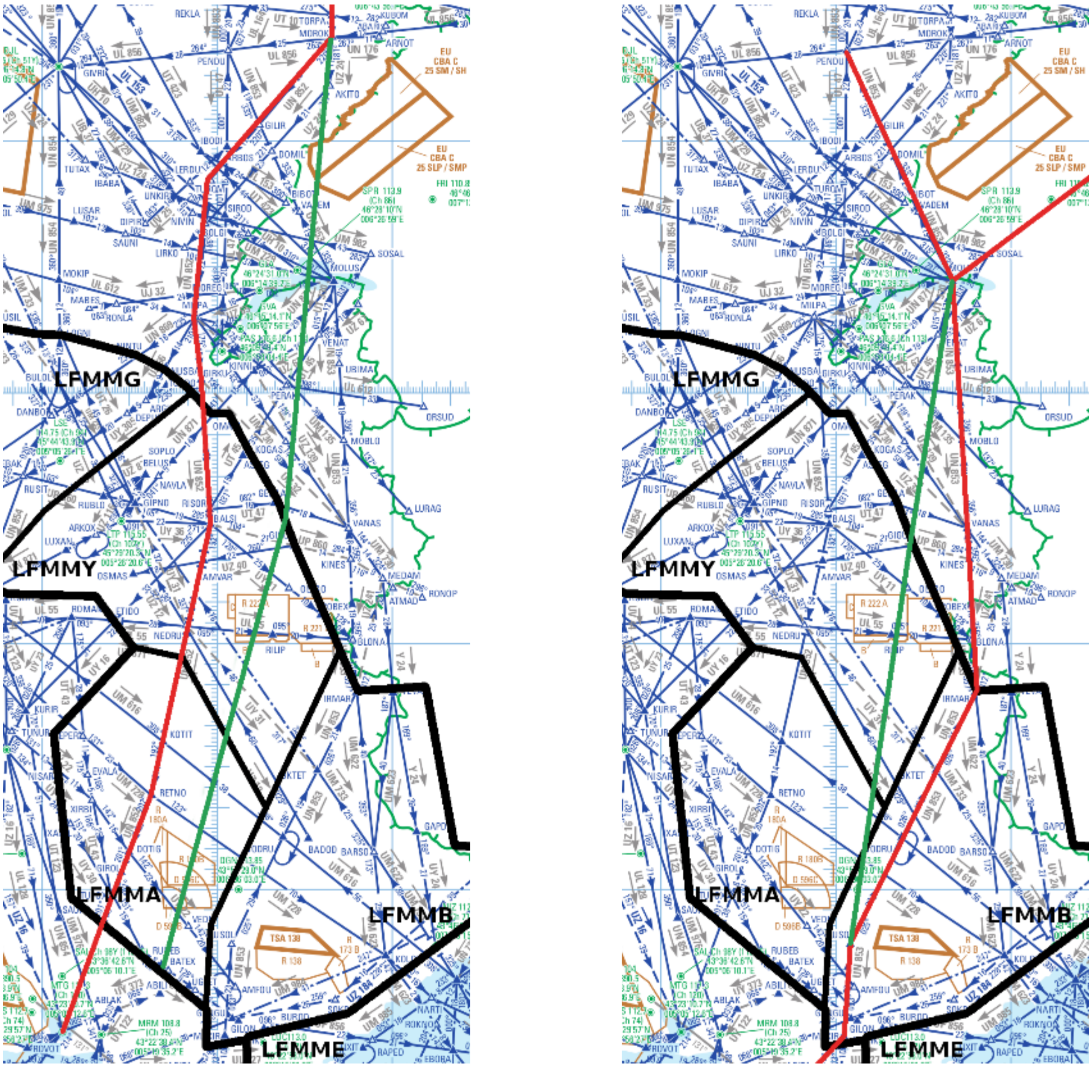
[20] Optimization was done for whole cluster although SAM were only defined for two sectors (blocks) A and Y.

[21] with the expertise of flow managers and controllers of the Aix ACC.



a) North-South route b) South-North route

Figure 54: Direct routes in the East cluster of the Aix ACC

2. Existing airspace sectors, through which direct routes pass, are divided creating horizontal SAM modules, buffer airspaces not separately controllable, that enable use of the direct routes. Figure 55 shows division of the airspace sectors LFMMY and LFMMA into SAM modules (marked SAM_Y and SAM_A in the figure respectively) and the remaining controllable airspaces (equivalent to DAC SBB module). The SAM modules could be collapsed with adjacent AB modules: LFMMB or LFMMY and LFMMA, enabling South-North or North-South direct route respectively (Figure 56).

3. The definition of new collapsed sectors containing newly created SAM modules, and new airspace configurations that include new collapsed sectors and direct routes as well. For example, in Figure 56b, sector LFMMB (SBB) and SAM modules SAM_Y and SAM_A are grouped creating collapsed sector (i.e. LFMMB_DN, where DN stands for Direct North) that enables direct route from South to North. In similar way, sectors LFMMA and LFMMB, that

create existing collapsed sector LFMMAB, adding SAM_Y module create new collapsed sector LFMMAB_DN, that as well enables direct route to north.

4. Finally, new airspace configurations, that encompass airspace sectorization and route structure, are created. For example, airspace configuration E3C_DN implies three active sectors: LFMMRAEE, LFMMAB_DN and LFMMGY, and beside standard ATS route includes direct route toward the north.

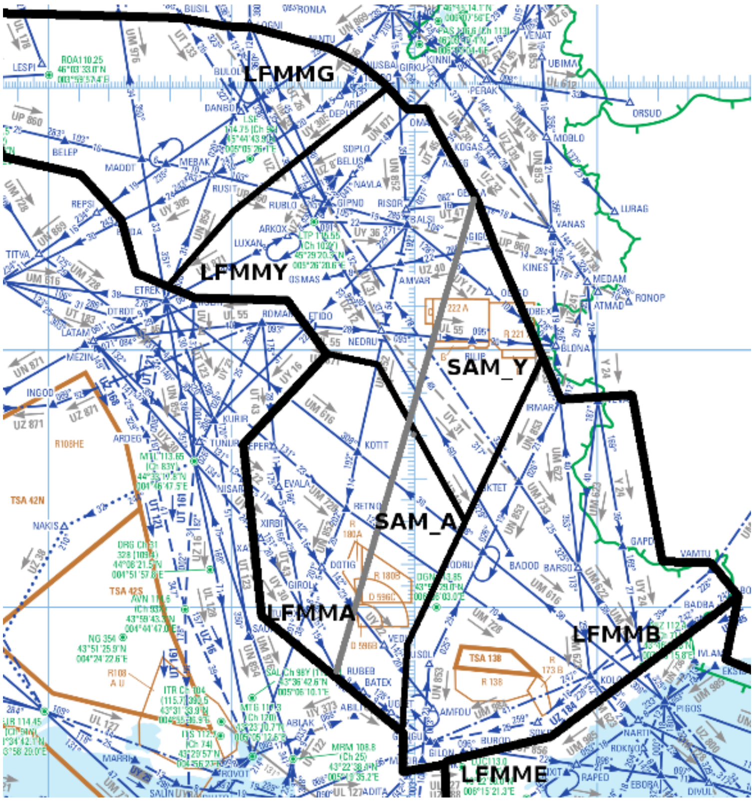
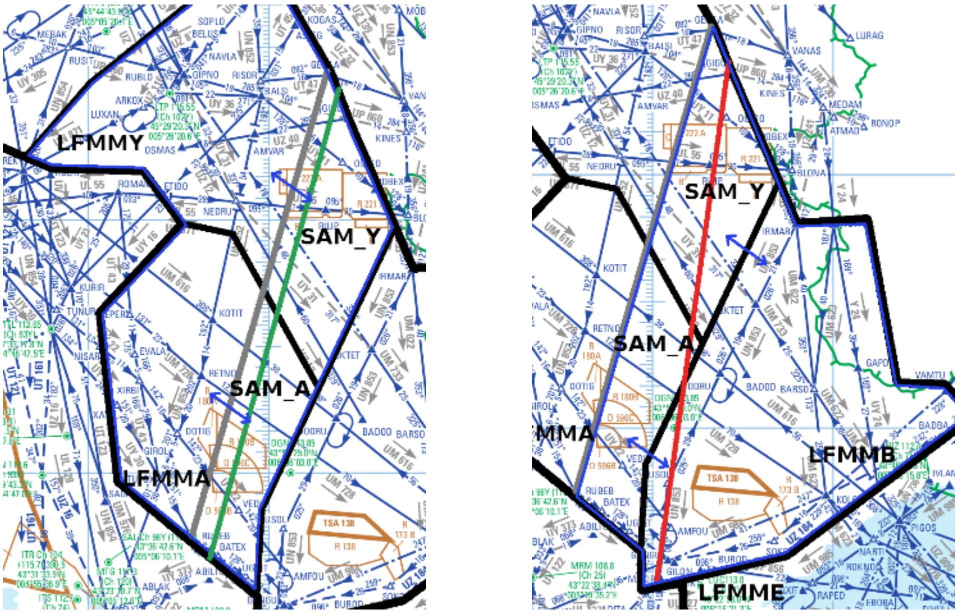


Figure 55: Proposal of the SAM modules (map source LF_AIP)



a) North-South direct route

b) South-North direct route

Figure 56: Collapsed sector (SAM+SBB) and enabled direct routes (map source LF_AIP)

The following main flows North-South (Figure 57) and South-North (Figure 58) were analysed:

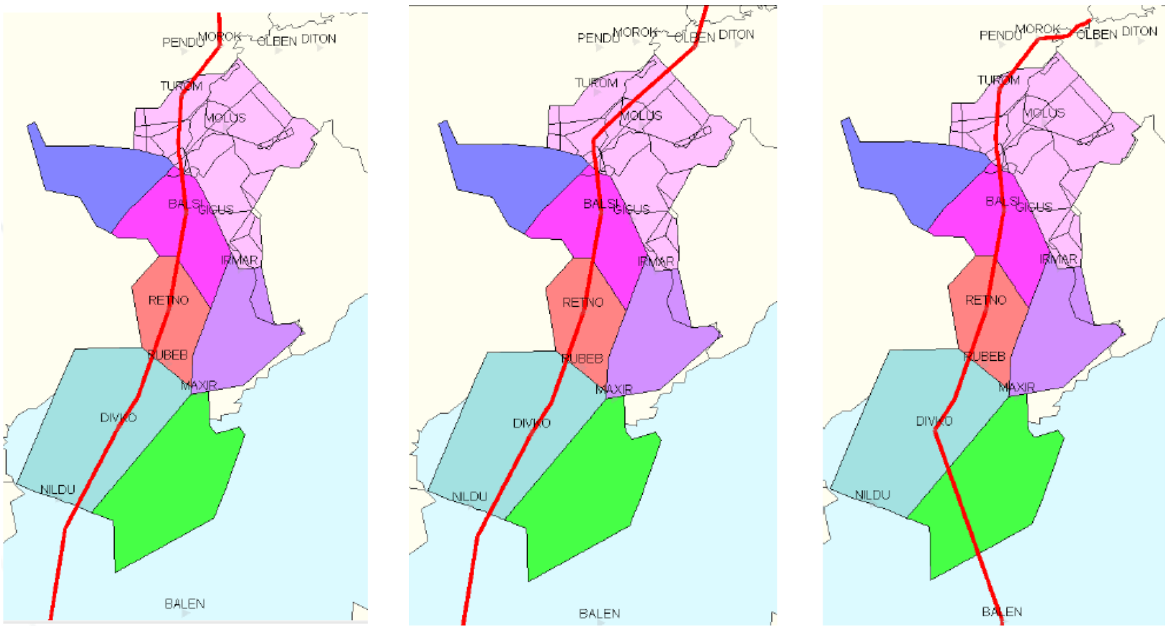


Figure 57: Main flows North-South (source DDR2 repository visualized with NEST tool)

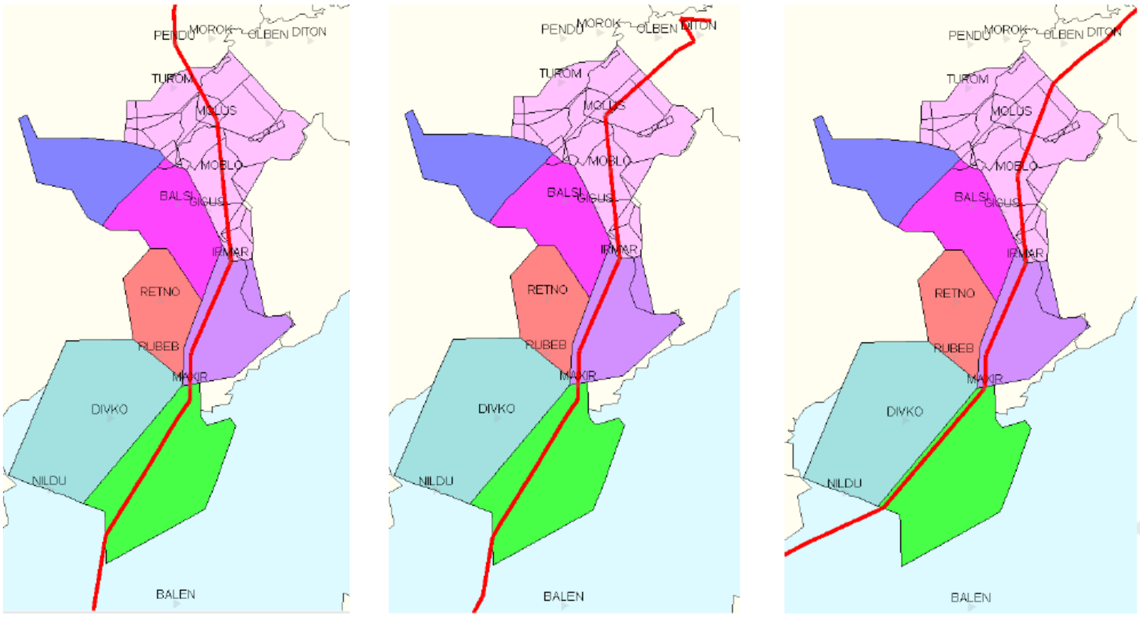


Figure 58: Main flows South-North (source DDR2 repository visualized with NEST tool)

The main crossing flows that could generate high level of complexity were the following: west-east crossing flows (Figure 59) and east-west crossing flows + Nice departure (Figure 60), and a prerequisite ratio between main and crossing flows that allows direct routes has been set to 3 based on the subjective judgment of the controllers. Such ratio should still guarantee acceptable level of complexity even with changed routes crossing structure (compared to standard crossing happening over designed way points).

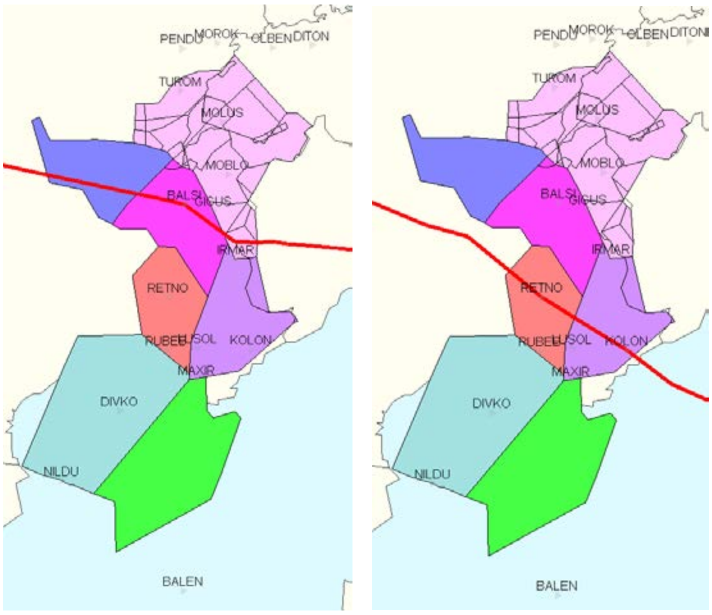


Figure 59: Crossing flows West-East (source DDR2 repository visualized with NEST tool)

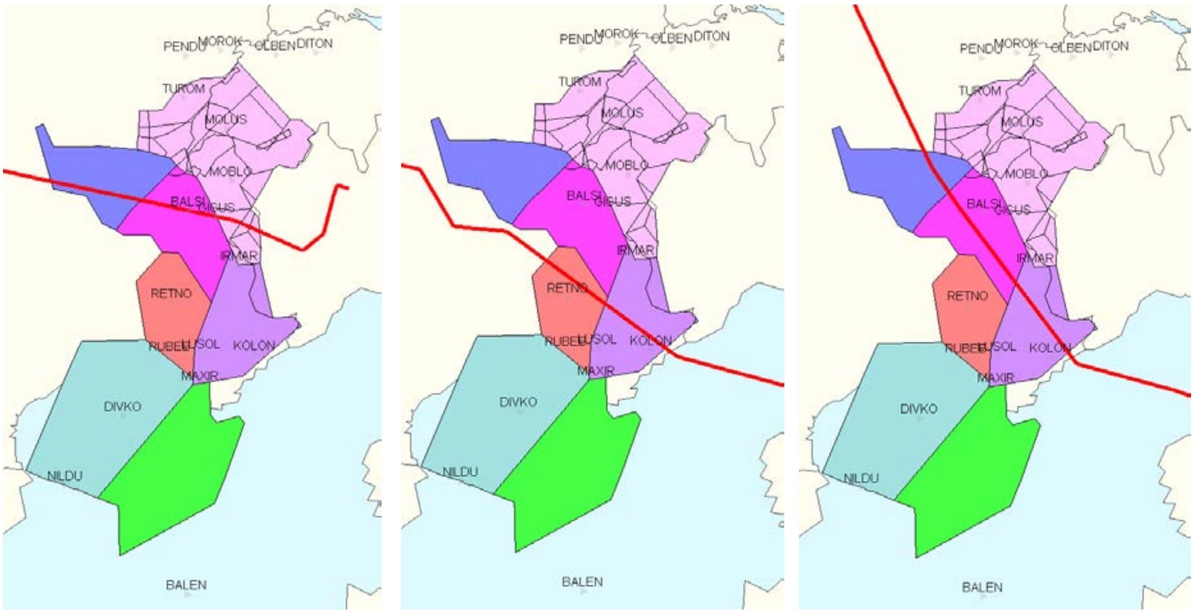


Figure 60: Crossing flows East-West (source DDR2 repository visualized with NEST tool)

5.5.1.1.2 Preliminary simulations

The first simulation of the preparatory activities results were not satisfactory showing almost no gain in the number of active positions and very limited exploitation of the direct routes.

Additional detailed analysis of the traffic flows revealed that main-crossing flows ratio was not that important, as initially thought, and as a result only few periods of the day (early morning and late evening) were compatible with this constraint. Figure 61 shows comparison of South-North (main, blue bars in the graph) and crossing flows (red bars in the graph) and as it may be seen density of the crossing flows (as defined in this exercise) for most periods of the day is higher than main flow density. Since significant part of the crossing flows are departure and arrival from/to Nice airport usually staying in the lower part of the airspace (Layers 1, 2, and rarely 3), to increase a chance for direct routes, it was decided to divide flows into two vertical segments: lower (Layers 1 and 2, up to FL355) and upper (layers 3 and 4, from FL355). However, as Figure 62 shows no significant benefits in the ratio of the main and crossing flows for the South-North upper traffic is achieved. Similar results are demonstrated for the North-South upper traffic (Figure 63), where favorable ratios were detected in the morning periods.

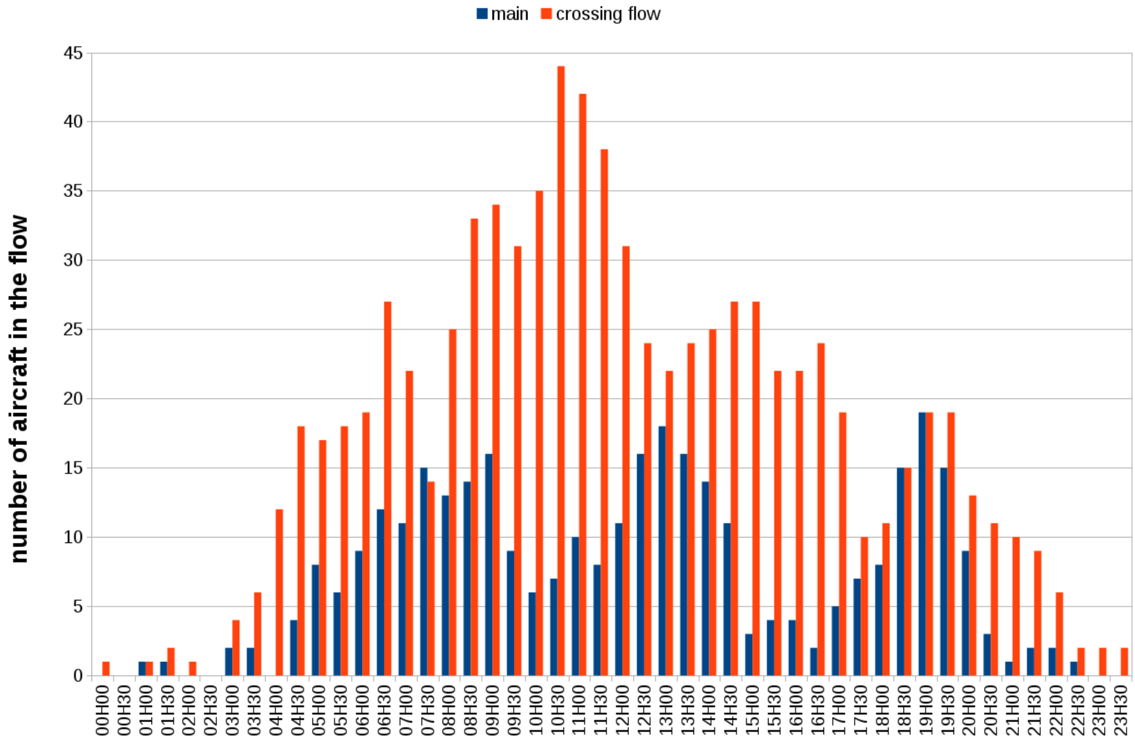


Figure 61: South-North main/crossing total flows comparison

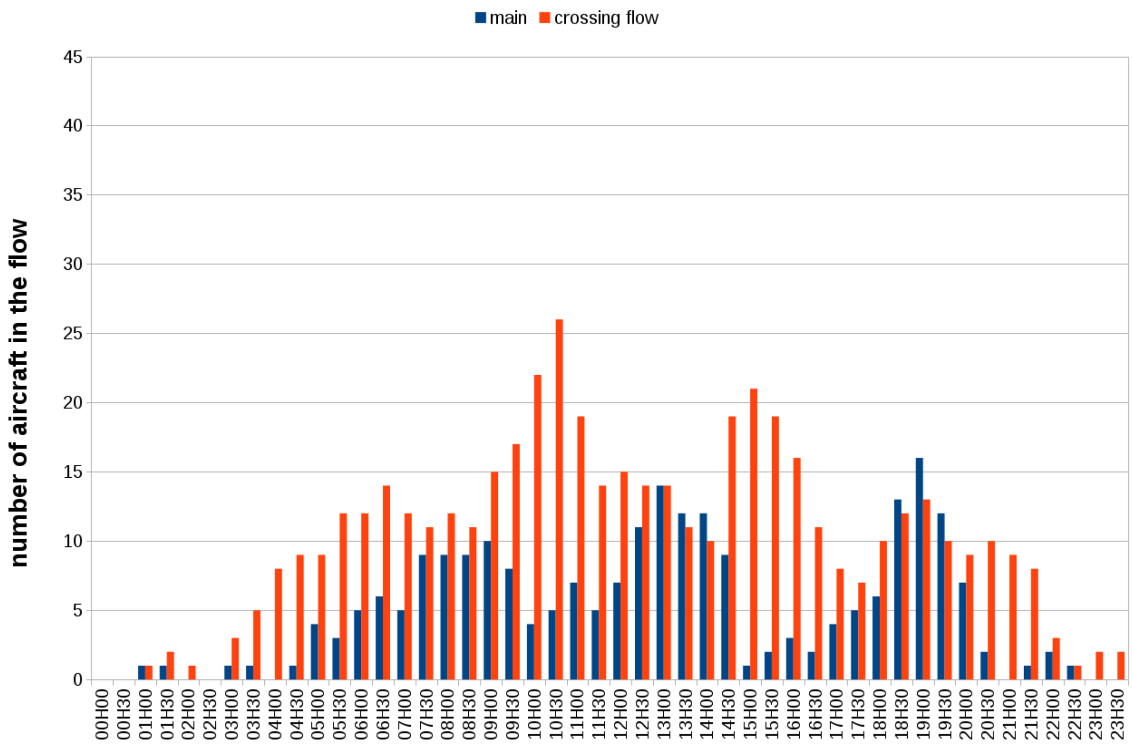


Figure 62: South-North main/crossing upper flows comparison

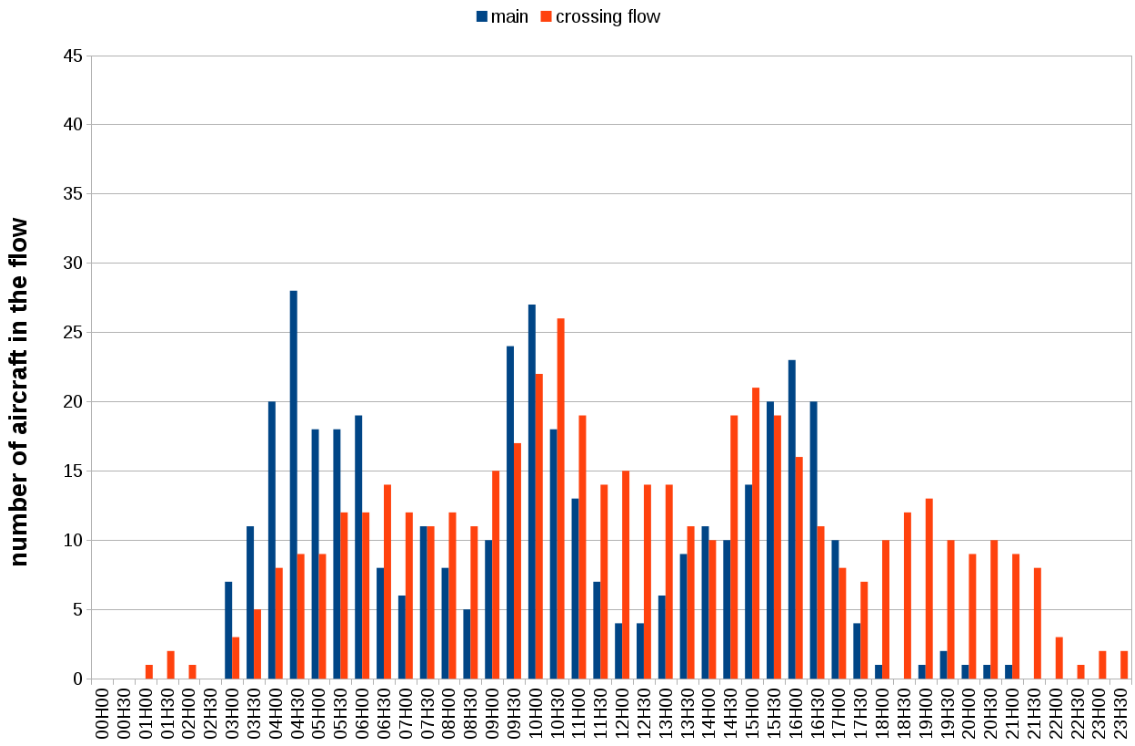


Figure 63: North- South main/crossing upper flows comparison

Table 103 shows concluding results of the traffic flow analysis, where green color represents periods when main/crossing flows constraint is satisfied and direct routes are allowed to be published. As previously commented results are not favorable and direct routes are available only in few periods in the early morning and late evening (when they are usually allowed by controllers in the operations on the tactical level). The performed analysis also suggested further steps in the exploitation of the direct route. The first suggestion was revision of the chosen main/crossing flows constraint (3:1) that was concluded to be very penalizing. The second suggestion was to revise the way flows are evaluated by measuring conflict probability or complexity instead of flow density (number of flights in the flow). The final recommendation included revision of the crossing flows and exclusion of the flows that will certainly be restricted by flow management measures (level capping, etc.) once direct routes are published (i.e. Nice and Geneva arrival/departure, etc.).

Table 103 : Direct route feasibility per period and vertical segment

	00H00	00H30	01H00	01H30	02H00	02H30	03H00	03H30	04H00	04H30	05H00	...	22H00	22H30	23H00	23H30
DN																
DNU																
DNL																
DS																
DSU																
DSL																

Beside direct route availability, the exercise also showed very limited benefits on the repartition of the control workload among active positions (controllers) and almost no reduction in the number of active positions. Figure 64 shows comparison of the average active sector underload (lower underload signifies better utilization of the sector capacity) between optimal and realized opening scheme in Aix East ACC in the morning period. Although optimization algorithm was able to find slightly better and more balanced distribution of the workload, no significant benefits in terms of number of active positions were reported.

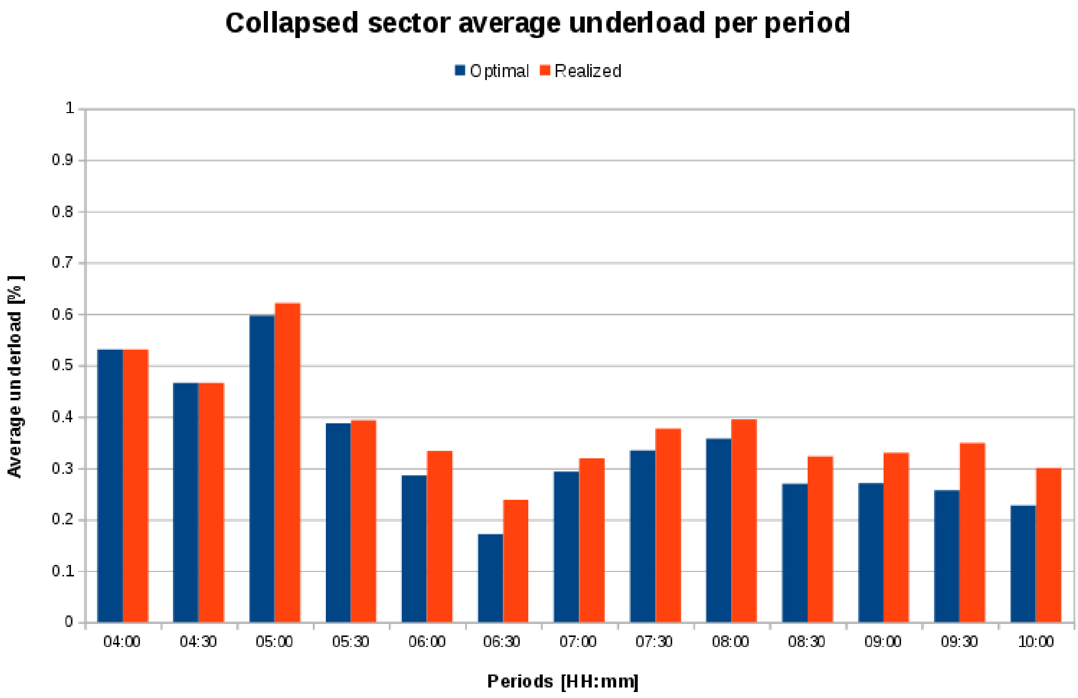
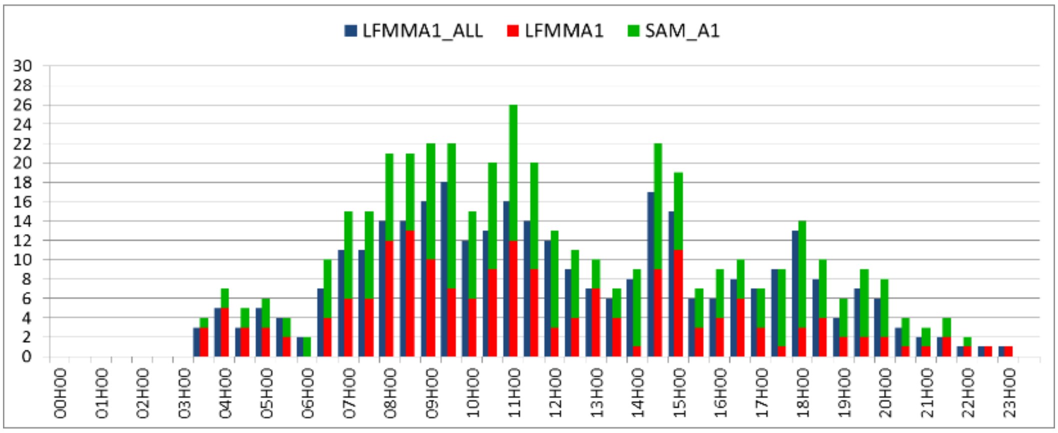


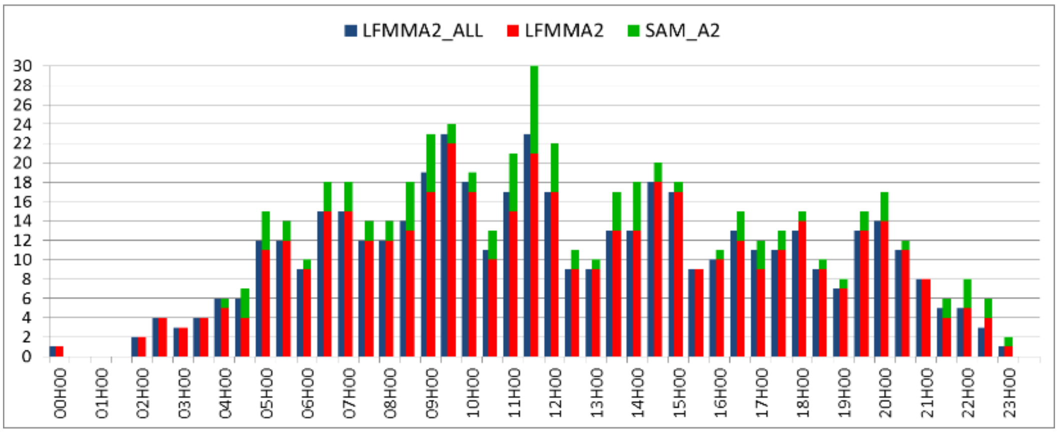
Figure 64: Comparison of the average active sector underload between optimal and realized opening scheme

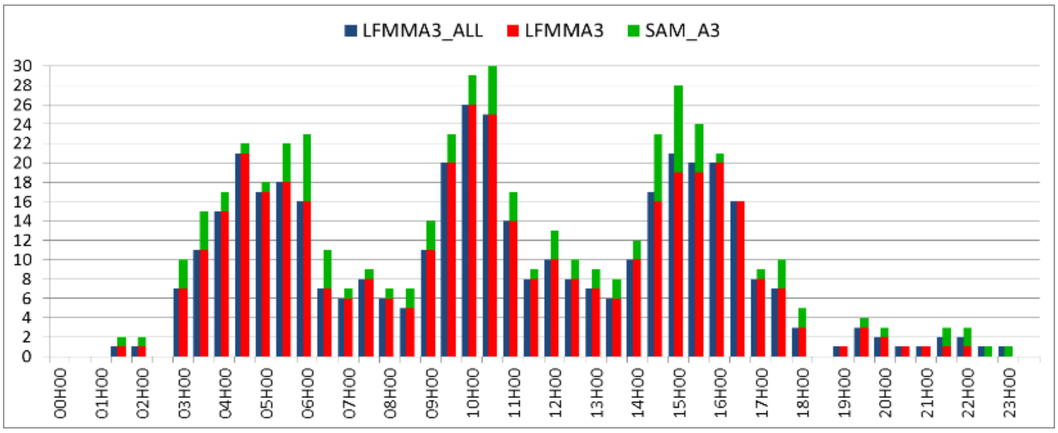
Detailed analysis of the sector entry count (number of aircraft entering sector in the next hour) surprisingly revealed that no significant reduction in the LFMMA and LFMMY sector loads are experienced with removal of the SAM_A and SAM_Y modules respectively.

Figure 65 shows comparison of the entry count of existing sector LFMMA (marked with LFMMA_ALL in the figure) represented with dark blue bars, and newly created SAM_A module (green bars) and the remaining LFMMA SBB airspace (red bars) represented with stacked bars at different vertical segments (layers). Except for the small reduction at lower vertical layer (Layer 1), coincidence of the blue and red bars confirms that load of new SBB block LFMMA is almost equivalent to the load of existing (whole) sector. Similar figures are shown for the LFMMY sector.

Equal load of new SBB blocks (compared to existing sectors) and consequently very low load of the SAM modules explain the difficulty of this exercise in improving sector capacity utilization and finding better airspace configuration.


LFMMA1_ALL
LFMMA1
SAM_A1
30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0
00H00 01H00 02H00 03H00 04H00 05H00 06H00 07H00 08H00 09H00 10H00 11H00 12H00 13H00 14H00 15H00 16H00 17H00 18H00 19H00 20H00 21H00 22H00 23H00


LFMMA2_ALL
LFMMA2
SAM_A2
30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0
00H00 01H00 02H00 03H00 04H00 05H00 06H00 07H00 08H00 09H00 10H00 11H00 12H00 13H00 14H00 15H00 16H00 17H00 18H00 19H00 20H00 21H00 22H00 23H00


LFMMA3_ALL
LFMMA3
SAM_A3
30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0
00H00 01H00 02H00 03H00 04H00 05H00 06H00 07H00 08H00 09H00 10H00 11H00 12H00 13H00 14H00 15H00 16H00 17H00 18H00 19H00 20H00 21H00 22H00 23H00

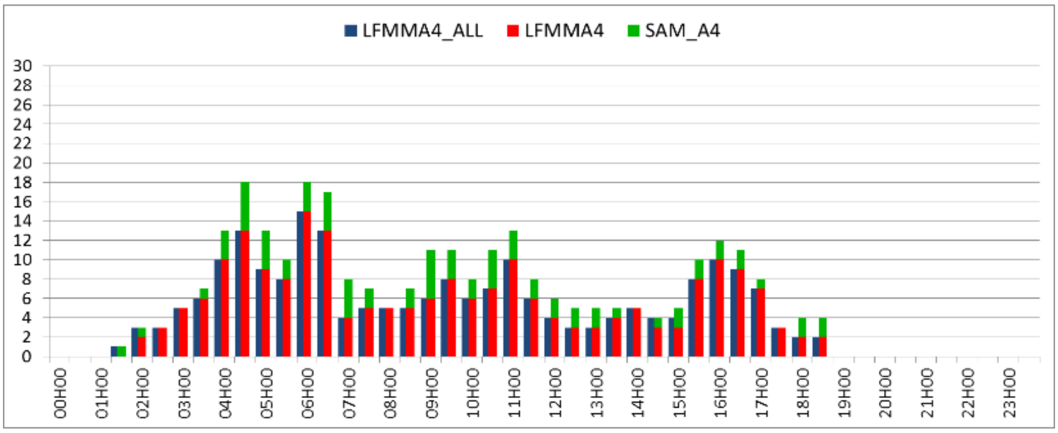
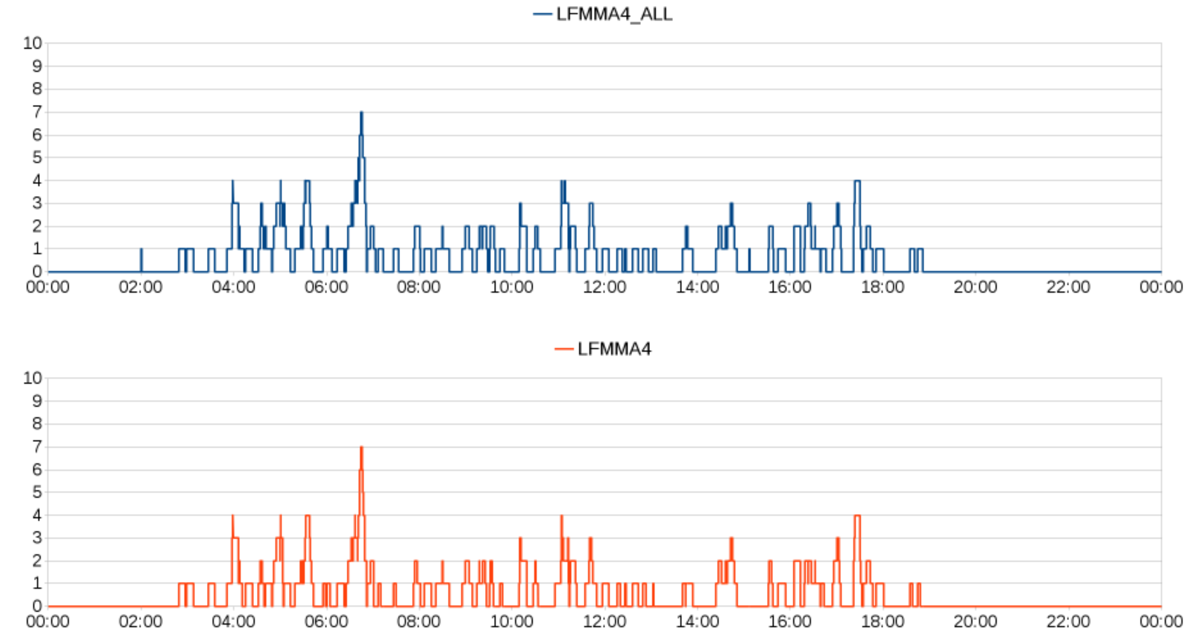


Figure 65: Entry count comparison of existing and divided sector LFMMA

The further effort to better represent sector load and capture load reduction has been made by using occupancy as the instantaneous number of aircraft presented in the sector for the given moment of time (i.e 1 second of step and duration). Figure 66 shows comparison of the occupancy of existing sector LFMMA4 (marked with dark blue color), SAM_A4 module (green color) and the remaining LFMMA4 SBB airspace (red color). Similar figures are shown for other vertical layers and sector LFMMY as well. However, it is concluded that occupancy measure does not show significant difference in the load, neither.



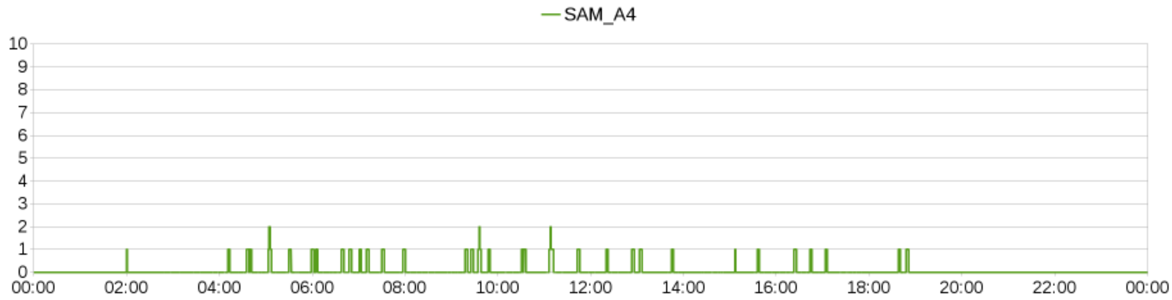


Figure 66: Occupancy comparison of existing and divided sector LFMMA4

Conclusion of sector load analysis is that with selected SAM and SBB modules very limited repartition of the sector load is possible and, hence, it would be very difficult to exploit this for a better airspace configuration. It should be noted, however, that this results are kind of expected, since proposal of the SBB and SAM block was direct results of consultation with controllers that are, under today's concept of operations, trained to work in the predefined sectors and since they were willing to accept the change in the operation suggested that SAM modules proposed doesn't involve any complexity. Also it should be noted that choice of different SAM modules may provide better results. Therefore suggestion for the future work is to define more different SAM modules and new collapsed sectors.

Consequently, as the first simulation results show no clear gain, it has been decided to stop this part of the exercise.

5.5.1.2 DAC decision support tool for FMP (LTM), EAP and Supervisors

The second subpart, based on an incremental approach, addresses the development of a set of services to build a DAC decision support tool provided to FMP (LTM) and Supervisor for the tactical phase (i.e. around -4h to -20 minutes), especially in case of heavy traffic load and to answer any emerging change or new event. .

Following the decision taken to stop the simulation described in the subsection above , the next paragraphs are focusing only on this exercise, the DAC decision support tool.

EXE-08.01-V2-VALP-005 mainly addresses mainly OI CM102B and the following associated the enablers reported in Table 104.

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)	*Develop v Uses	*Requir ed v Optional
SESAR Solution 08.01	Management of Dynamic Airspace Configurations	C	**Solution 08.01 focus on validation of Dynamic Airspace Configurations (DAC) and Dynamic Mobile Areas (DMAs) of**	**CM-0102-B**	AAMS-19	Dev	R

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)	*Develop v Uses	*Requir ed v Optional
			types 1 and 2 in FRA that enable flexible solutions that can be dynamically adapted to traffic demand to respond to different regional/local performance objectives, which may vary in time and place up to concept maturity level 2				

Table 104: EXE-08.01-V2-VALP-005 OI and Enablers addressed

Although not required by EATMA, the project has identified the enablers that will be developed during the project's lifecycle and those which will be used during the validation activities.

The operational concepts and use cases addressed by the exercise EXE-08.01-V2-VALP-005 are defined in SESAR Solution 08.01 OSED Part I:

- Section 3.3.2.5 DAC within INAP time horizon
- Section 3.3.2.9 Use Cases:
  - UC 16: INAP1 - Research of the DAC/ACC optimized sector configurations
  - UC 17: INAP2 - Selection of DAC/sector configuration
  - UC 18: INAP3 - Exploratory analysis

5.5.2 Stakeholder's expectations and Benefit mechanisms addressed by the exercise

Stakeholder	Involvement	Why it matters to stakeholder
European Network Manager	Direct involvement, as part of the concept and validation teams	The wish to ensure effective consolidation between all the stakeholders towards an optimized European airspace configuration. Contribution to European performance

		To ensure that local DAC initiatives cannot lead to negative effect. The need to ensure feasibility of the tools and procedures.
ANSP/DSNA	Leader of the validation exercise (preparation, execution and results analysis) and provider of ATM expertise.	Crucial need of an optimized use of airspace and in airspace capacity increase (without jeopardizing safety) through the use of a decision support tool for Dynamic Airspace Configuration. The assessment of cost efficiency through optimum use of available human staffing. To ensure that the roles and responsibilities of the FMP (LTM) and supervisor with regard to the concept are clearly defined. To guarantee that the appropriate decision support tool and information and procedures used to optimize the airspace configuration are provided. To ensure the usability of such a support tool.
Airspace Users	No direct involvement in the exercise. However, interested in the outcome.	User preferred routing facilitation Flexibility
European Commission	Direct participation through SJU	The EC is particularly interested in the KPA's which involve predictability, cost efficiency, safety, fuel efficiency.

Table 105: Stakeholders' expectations addressed in Validation Exercise EXE-08.01-V2-VALP-005

The benefit mechanism identified for the concept improvements targeted by the exercise are presented in the figure below. Considering the features and objectives of the EXE-08.01-V2-VALP-005, some indicators/KPAs presented in the diagram could not be addressed; they are greyed out.

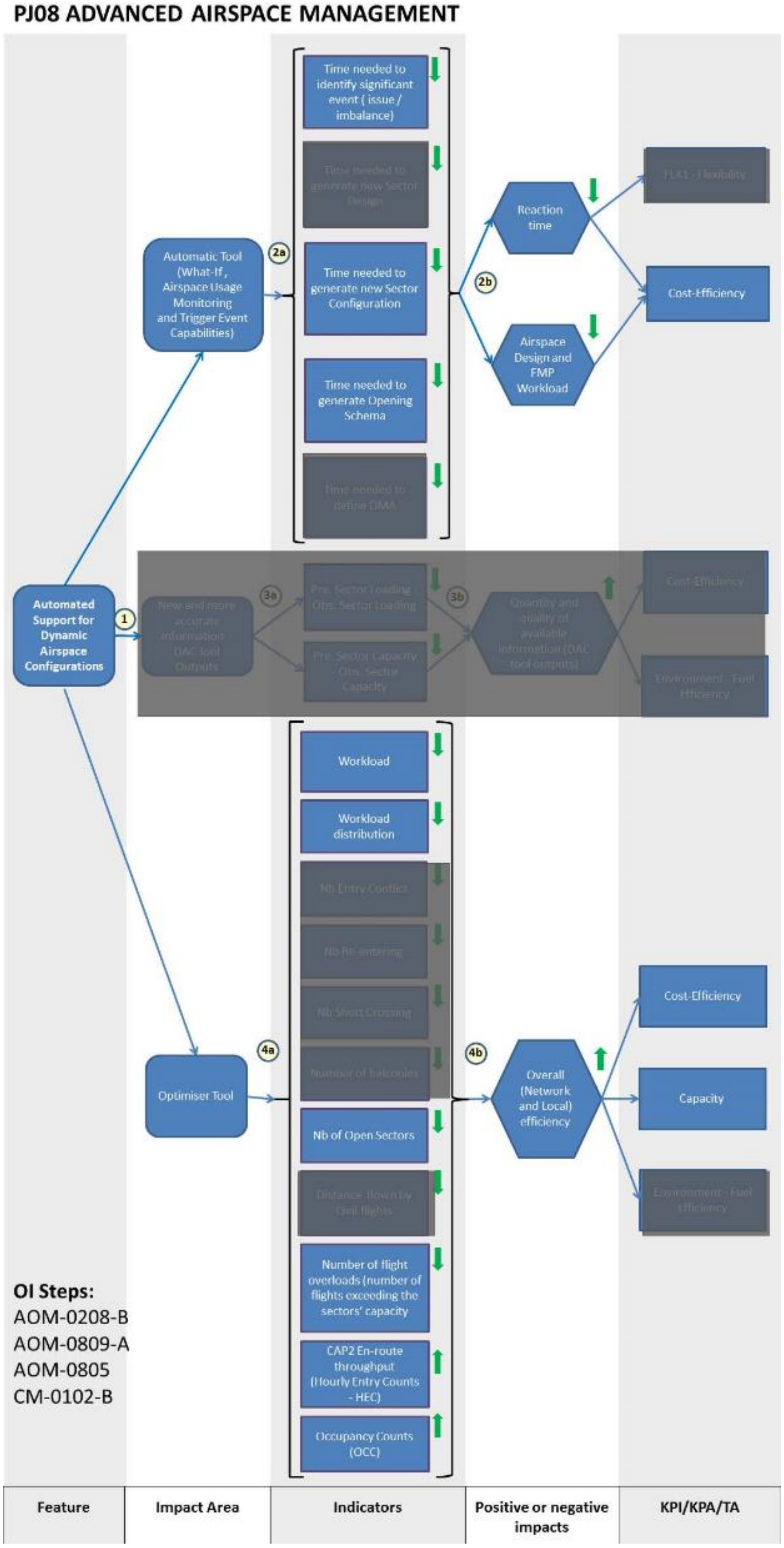


Figure 67: Benefit Mechanism addressed by EXE-08.01-V2-VALP-005 - Automated Support for Dynamic Airspace Configurations

5.5.3 Validation objectives

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage[22] and comments on the coverage of SESAR Solution Validation Objective in Exercise #05	Exercise Validation Objective	Exercise Success criteria
OBJ-08.01-V2-VALP-PE1	CRT-08.01-V2-VALP-PE1-002	Partially covered with regard to the Success Criterion considered and the KPI calculated	**EX5-OBJ-08.01-V2-VALP-PE1-002** To determine if predictability is increased, assuming that a more optimized airspace configuration will lead to a better resilience of the management of traffic flows.	**EX5-CRT-08.01-V2-VALP-PE1-002** From a quantitative point of view, a best use of the available airspace leads to the identification and the implementation of appropriate measures (i.e. less regulation or much better regulation; shorter delays; decrease in flight duration variability).
	CRT-08.01-V2-VALP-PE1-003	Partially covered with regard to the Success Criterion considered and the KPI calculated	**EX5-OBJ-08.01-V2-VALP-PE1-003** To determine if cost efficiency is increased, assuming that a best use of available airspace and human resources will lead to a reduction in ATC workload at a lower technology costs.	**EX5-CRT-08.01-V2-VALP-PE1-003** A more optimized airspace configuration (a) avoid the possibility of delays and/or the application of regulation due to capacity constraints, and (b) minimize the number of opened sectors (and consequently the number of ATCOs) for a fixed traffic while increasing safely number of flights per ATCO hours.
	CRT-08.01-V2-VALP-PE1-004	Partially covered with regard to the Success Criterion considered and the KPI calculated	**EX5-OBJ-08.01-V2-VALP-PE1-004** To assess whether safety standards are still at an acceptable level.	**EX5-CRT-08.01-V2-VALP-PE1-004** Safety is not degraded (at least (a) a better workload distribution, (b) number of reentering, (c) short crossing and (d) balconies remain equivalent and common situation awareness is increased due to automated tools.) (no target)

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage[22] and comments on the coverage of SESAR Solution Validation Objective in Exercise #05	Exercise Validation Objective	Exercise Success criteria
	CRT-08.01-V2-VALP-PE1-005	Partially covered with regard to the Success Criterion considered and the KPI calculated	**EX5-OBJ-08.01-V2-VALP-PE1-005** To assess if DAC has a positive impact on traffic due to a better allocation of airspace	**EX5-CRT-08.01-V2-VALP-PE1-005** The optimized solutions proposes an efficient use of the available capacity (no. target)
OBJ-08.01-V2-VALP-TF1	CRT-08.01-V2-VALP-TF1-001	Partially covered with regard to the Success Criterion considered and the KPI calculated	**EX5-OBJ-08.01-V2-VALP-TF1-001** To carry out an initial assessment on the most appropriate automated tools and their impact for DAC.	**EX5-CRT-08.01-V2-VALP-TF1-001** The requirements defined for automated support tools are appropriate
	CRT-08.01-V2-VALP-TF1-002	Partially covered with regard to the Success Criterion considered	**EX5-OBJ-08.01-V2-VALP-TF1-002** To carry out an initial assessment on the usability of automated tools provided to support the identification of the most optimized airspace configurations	**EX5-CRT-08.01-V2-VALP-TF1-002** The automated tools provided to assess, and compare the different airspace configurations is fit for use and support the actors in their decision making tasks.

[22] All the validation objectives are partially covered mainly due to lack of Free Route and lack of traffic sample 2023 and only focus on some actors (i.e. FMP and SUP)

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage[22] and comments on the coverage of SESAR Solution Validation Objective in Exercise #05	Exercise Validation Objective	Exercise Success criteria
OBJ-08.01-V2-VALP-OF1	CRT-08.01-V2-VALP-OF1-001	Partially covered with regard to the Success Criterion considered	**EX5-OBJ-08.01-V2-VALP-OF1-001** To carry out an assessment that the human operator is able to successfully accomplish tasks linked to the airspace configuration activities.	**EX5-CRT-08.01-V2-VALP-OF1-001** Through the use of automated tool, the reaction time is reduced (i.e. *the reduction of time needed to identify significant events, to generate sector configurations and/or to generate opening schema*) as well as the mental and task workloads of Supervisor and FMP. Consequently, the two actors are available to focus on other activities.
	CRT-08.01-V2-VALP-OF1-002	Partially covered with regard to the Success Criterion considered	**EX5-OBJ-08.01-V2-VALP-OF1-002** To carry out an initial assessment on the operational procedures and the different roles of the actors involved in the DAC process	**EX5-CRT-08.01-V2-VALP-OF1-002** The proposal of operational procedures and identification of the different roles linked to the DAC process
	CRT-08.01-V2-VALP-OF1-003	Partially covered with regard to the Success Criterion considered	**EX5-OBJ-08.01-V2-VALP-OF1-003** To assess the operational feasibility of DAC concept and the acceptability level of supervisors and FMPs.	**EX5-CRT-08.01-V2-VALP-OF1-003** The exercise provides evidence that DAC principles are compatible with the working methods of the different actors involved and leads to a high level of acceptability by operators.

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage[22] and comments on the coverage of SESAR Solution Validation Objective in Exercise #05	Exercise Validation Objective	Exercise Success criteria
	CRT-08.01-V2-VALP-CO1-002	Partially covered with regard to the Success Criterion considered	**EX5-OBJ-08.01-V2-VALP-CO1-002** To assess that the DAC principles are compatible with DCB concept.	**EX5-CRT-08.01-V2-VALP-CO1-002** The exercise provides evidence that DAC principles are compliant with the DCB concept

Table 106: Validation Objectives addressed in Validation Exercise EXE-08.01-V2-VALP-005

5.5.4 Validation scenarios

Dynamic Airspace Configuration concept and its operational feasibility are validated through the use of a decision support tool for FMP and supervisors (actors involved in the scenarios), *SINAPS (Swim Integrated Network management and ATC Planning Services)*. Two different modes in the use of SINAPS are proposed:

- A Fast Time Simulation with traffic samples recorded during three days in July 2018 (the 26th, 27th and 28th of July) in Bordeaux ACC and based on ATC data. During these 3 days observations were completed in the OPS room with quantitative and qualitative data in order to have all the appropriate data to build the environment and reference scenarios. This simulation will be divided into two different modes:

For this FTS, the relevant information will be provided to operational actors (i.e. meteorological conditions, flow management constraints, the published 'D-1' plan, the number of available staff and all the known exogenous factors (i.e. the Tour de France impact)). This simulation will be divided into two different sub-modes:

- The catalogue used: the conventional one (i.e. the currently used configurations in Bordeaux ACC as declared at NM) and the exploratory one (with new optimized ACC sector configurations)
- The path: it means that the configuration proposed by SINAPS starts from the configuration currently deployed to the proposed one, or without it (means that it widens the scope of possibilities).

Using both modes (2 catalogues x path), for a selected slot:

- FMP will adapt the plan to the tactical traffic flow, ACC supervisor will choose the airspace configuration to be deployed.

During all the simulation, they will be observed through an observation grid taking into account their behaviors (i.e. the number of different configuration propositions analyzed and the time spend ; the number, the kind and the time spend to analyze occupancy curves, the time to take a decision, and the evolution in the prevision plan).

At the end of the simulation a debriefing will be proposed and they will face the real situation (i.e. the real tactical plan made by the FMP and the real deployed configuration focusing on the number of opened sectors and the kind of configuration).

- A Passive Shadow Mode with catalog mode planned from the 25th to the 29th of September. During this mode, two actors (1 supervisor and 1 FMP) will manipulate SINAPS as 'in real operational life' using real ATC data. As for the Fast Time Simulation, the FMP, using only information from SINAPS, will adapt the plan to the tactical traffic flow, and the ACC supervisor will take a decision for the configuration he would deploy as if he was the actual supervisor. During the Passive Shadow Mode, their behaviors will be recorded through the use of an observation grid. A debriefing will be handled for each couple of FMP-Supervisor. Several slots will be offered in order to get feedback from a wide range of different operational people and to have a representative qualitative assessment.

5.5.4.1 General description of Bordeaux ACC

For completeness, in this section a general description of the Bordeaux ACC including the sector configurations currently used. Bordeaux ACC is a medium complexity ACC, with complex sectors composing it, with positions allocated according to the kind of airspace and to the workload.

The current Bordeaux ACC airspace organization is represented in Figure 68 .

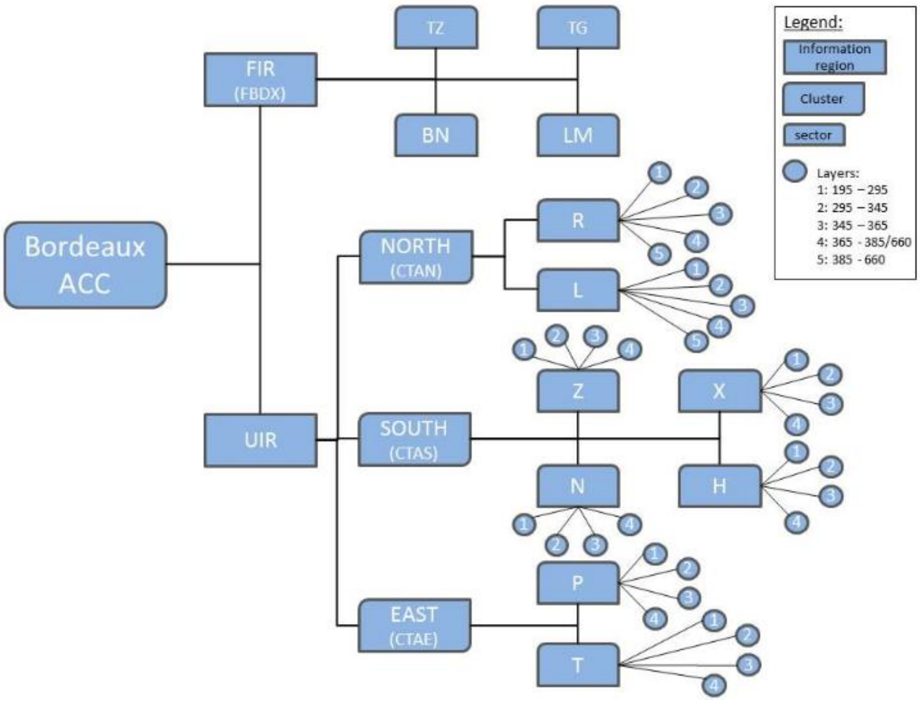


Figure 68: Current Bordeaux ACC configuration

Sectors in Bordeaux ACC are split into four main areas, which are (Figure 69 **&** Figure 70):

- FIR sectors[23]: TZ – TG – BN – LM.
- Northern cluster (UIR – CTAN): R – L.
- Southern cluster (UIR – CTAS): H – N – Z – X.
- Eastern cluster (UIR-CTAE): P – T.

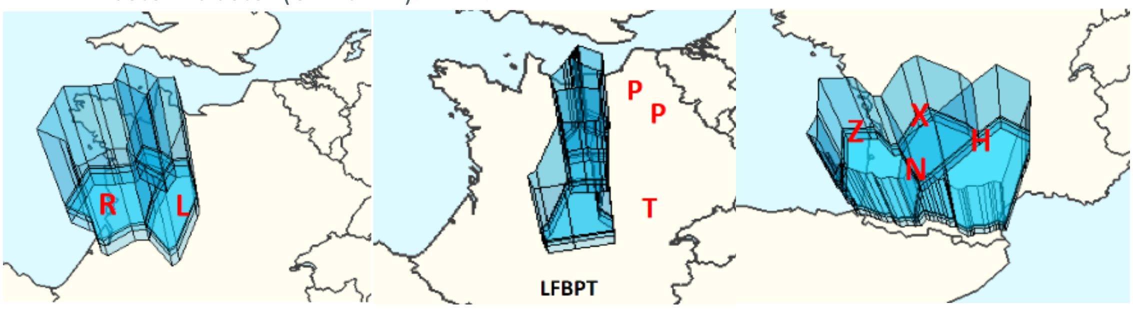


Figure 69: Bordeaux ACC sectors - UIR

[23] Under the AIRAC definition, FIR sectors are integrated, for practical reasons, in the Eastern cluster. These sectors are, though, managed independently of the sectors P-T.

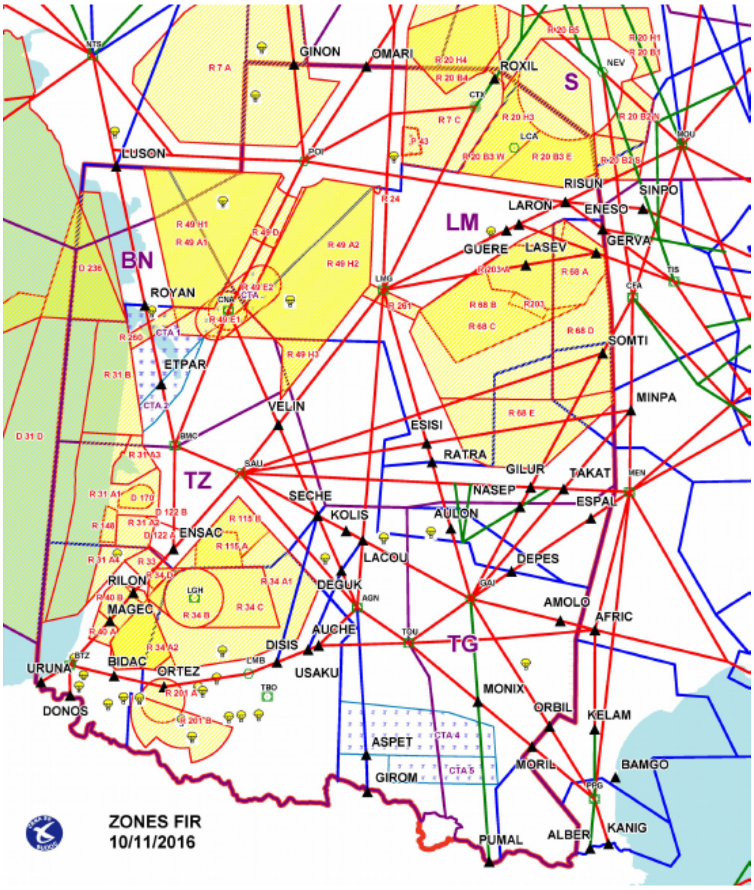


Figure 70: Bordeaux ACC sectors - FIR

Configurations

Bordeaux ACC UIR Sectors can be identified into 3 main clusters, divided to better define the different configurations (Figure 71). Inside these different clusters, we can rapidly enumerate all the possible sector configurations with the sectors for which monitoring values are declared[24]. It helps to find a determinist solution for any given situation.

[2424] With AIRAC 1803, we can enumerate 5 sector configurations for FIR, 49 for CTAE, 281 for CTAN and 4711 for CTAS.

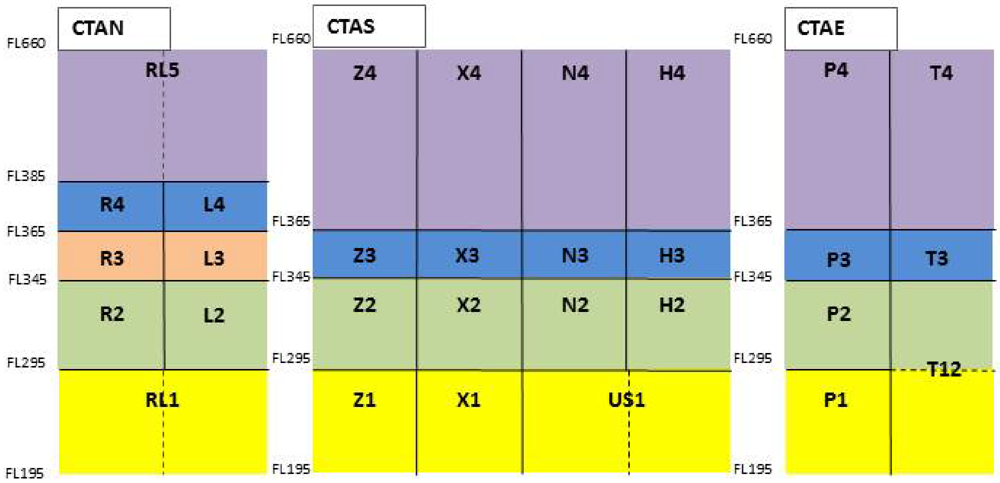


Figure 71: Operational Sectorisation Layout

5.5.4.2 General description of scenarios

Passive Shadow Mode

For the Passive Shadow Mode, observations will be made during 5 days (25/09/2018 to 29/09/2018). It aims to capture the use of SINAPS in the Airspace configuration process.

As the Passive Shadow Mode will use real traffic, scenarios are not described in this document. We will focus on different time windows identified by operational experts as interesting and meaningful in terms of airspace configuration activities.

The different slots identified are:

- 0400-0600 UTC,
- 0600-0800 UTC,
- 0800-1100 UTC,
- 1100-1400 UTC,
- 1400-1730 UTC.

Fast Time Simulation (currently used configurations and exploratory modes)

Traffic samples were recorded during three days in July 2018 (the 26th, 27th and 28th of July) in Bordeaux ACC and based on real traffic data. For each record period, the events that could impact the sector configuration were observed (weather, regulations, …). In view of these observations, traffic samples to be used in the exercise have been selected taking into account:

- traffic characteristics,
- complexity in the assessment of traffic load,

- difficulty in the decision making process.

The analysis of real traffic data led to the selection of 2 days (divided into 5 scenarios)

The various scenarios identified for EXE-08.01-V2-VALP-005 Fast Time Simulations are summarized in the table below.

Identifier	Scenario
SCN-08.01.05-VALP-0001	Current airspace design/management methodology and tools in Bordeaux ACC (Reference scenario #01) Traffic: 27 July 2018 (0400-0630 UTC)
SCN-08.01.05-VALP-0002	Current airspace design/management methodology and tools in Bordeaux ACC (Reference scenario #02) Traffic: 27 July 2018 (0700-1100 UTC)
SCN-08.01.05-VALP-0003	Current airspace design/management methodology and tools in Bordeaux ACC (Reference scenario #03) Traffic: 27 July 2018 (1345-1445 UTC)
SCN-08.01.05-VALP-0004	Current airspace design/management methodology and tools in Bordeaux ACC (Reference scenario #04) Traffic: 28 July 2018 (0400-0645UTC)
SCN-08.01.05-VALP-0005	Current airspace design/management methodology and tools in Bordeaux ACC (Reference scenario #05) Traffic: 28 July 2018 (0830–1030 UTC)
SCN-08.01.05-VALP-1001	DAC with the decision support tool for Supervisor and FMP (Solution scenario #01a)
	Exploratory Analysis : comparison and assessment of outcomes and results in terms of performance targets achievement in order to conclude on efficiency of new optimized ACC sector configurations obtained (Solution scenario #01b)
SCN-08.01.05-VALP-1002	DAC with the decision support tool for Supervisor and FMP (Solution scenario #02a)
	Exploratory Analysis : comparison and assessment of outcomes and results in terms of performance targets achievement in order to conclude on efficiency of new optimized ACC sector configurations obtained (Solution scenario #02b)
SCN-08.01-05-VALP-1003	DAC with the decision support tool for Supervisor and FMP (Solution scenario #03a)
	Exploratory Analysis : comparison and assessment of outcomes and results in terms of performance targets achievement in order to conclude on efficiency of new optimized ACC sector configurations obtained (Solution scenario #03b)
SCN-08.01-05-VALP-1004	DAC with the decision support tool for Supervisor and FMP (Solution scenario #04a)

Identifier	Scenario
	Exploratory Analysis : comparison and assessment of outcomes and results in terms of performance targets achievement in order to conclude on efficiency of new optimized ACC sector configurations obtained (Solution scenario #04b)
SCN-08.01-05-VALP-1005	DAC with the decision support tool for Supervisor and FMP (Solution scenario #05a)
	Exploratory Analysis : comparison and assessment of outcomes and results in term of performance targets achievement in order to conclude on efficiency of new optimized ACC sector configurations obtained (Solution scenario #05b)

Table 107: EXE-08.01-V2-VALP-005 scenarios list

5.5.4.3 Reference Scenario(s)

In order to define the reference scenarios, the following aspects have been taken into account according to the different objectives pursued along the day:

- in the morning, their primary objective is to optimize the sectors splitting;
- in the evening, they aim to facilitate the way to collapse sectors;
- during the day, they tend to minimize the number of open CWP.

<u>Traffic information</u>

Reference scenarios will consider the following traffic days:

- the 27 of July from 04:00 (UTC) to 17:30 (UTC)
- The 28 of July from 04:00 (UTC) to 09:00 (UTC)

Taking into account all these elements, Table 108 describes the EXE-08.01-V2-VALP-005 Reference Scenarios.

Identifier	General description
SCN-08.01.05-VALP-0001	Scenario characteristics: Tactical management with the need to take into account meteorological constraints and to deal with the HR management and airspace capacity Day(Hour): 27/07/2018 (0700-1100 UTC) Concerned sectors: Bordeaux ACC
SCN-08.01.05-VALP-0002	Scenario characteristics: tactical management with alternative solutions to handle the meteorological conditions and regulations Day(Hour) 27/07/2018 (1345-1445 UTC) Concerned sectors: Bordeaux ACC

Identifier	General description
SCN-08.01.05-VALP-0003	Scenario characteristics: Optimization of the first opening scheme Day(Hour) 28/07/2018 (0400-0645 UTC) Concerned sectors: Bordeaux ACC
SCN-08.01.05-VALP-0004	Scenario characteristics: tactical management with alternative solutions to optimize capacity Day(Hour): 28/07/2018 (0830-1030 UTC) Concerned sectors: Bordeaux ACC

Table 108: EXE-08.01-V2-VALP-005 reference scenarios description

5.5.4.4 Solution Scenario(s)

Solution scenarios defined in this section will be compared against the Reference scenarios defined in the previous section.

Traffic information

As for the reference scenario, solution scenarios will consider the following traffic days:

- the 27 of July from 04:00 (UTC) to 17:30 (UTC)
- The 28 of July from 04:00 (UTC) to 09:00 (UTC)

This paragraph lists the runs considered for the Solution Scenarios to be executed in order to validate respectively Dynamic Airspace Configuration concept and the operational feasibility using a decision support tool for the optimization of sector configuration and ATC opening scheme, focusing on FMPs and Supervisors.

Run	Identifier	Scenario
1	SCN-08.01.05-VALP-1001 To be compared to SCN-08.01.05-VALP-0001	DAC with the decision support tool for Supervisor and FMP (Solution scenario #01a) Exploratory Analysis: comparison and assessment of outcomes and results in terms of performance targets achievement in order to conclude on efficiency of new optimized ACC sector configurations obtained (Solution scenario #01b). Results could also be compared to results from solution scenario #01a
2	SCN-08.01.05-VALP-1002 To be compared to SCN-08.01.05-VALP-0002	DAC with the decision support tool for Supervisor and FMP (Solution scenario #02a) Exploratory Analysis: comparison and assessment of outcomes and results in terms of performance targets achievement in order to conclude on efficiency of new optimized ACC sector

Run	Identifier	Scenario
		configurations obtained (Solution scenario #02b). Results could also be compared to results from solution scenario #02a
3	SCN-08.01-05-VALP-1003 To be compared to SCN-08.01.05-VALP-0003[25]	DAC with the decision support tool for Supervisor and FMP (Solution scenario #03a)
4	SCN-08.01-05-VALP-1004 To be compared to SCN-08.01.05-VALP-0004	DAC with the decision support tool for Supervisor and FMP (Solution scenario #04a) Exploratory Analysis: comparison and assessment of outcomes and results in terms of performance targets achievement in order to conclude on efficiency of new optimized ACC sector configurations obtained (Solution scenario #04b). Results could also be compared to results from solution scenario #04a

Table 109: EXE-08.01-V2-VALP-005 solution scenarios description

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[25] This scenario will not be played using the full exploratory mode because it was not well adapted due to the high number of possibilities but recommendations will be made in the Validation report for this specific case

5.5.5 Exercise Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
	Usability of the decision support tool for supervisor and FMP is good	HMI	A specific interface is developed for this exercise and judged by UX and operational experts before the exercise		Execution	CAP HP	PJ.08-01.05	N/A	PJ.08-01	Medium
	Availability of adequate data and tools	Data quality constraints	The adequate data and tools are provided to reach realism of operational reference scenario	V2 maturity level, in tactical phase	Tactical phase	CAP SAF ENV	PJ.08-01	N/A	PJ.08-01	High

Table 110: Validation Exercise Assumptions

5.5.6 Limitations and impact on the level of Significance

The potential limitations of EXE-08.01-V2-VALP-005 are listed below:

- There is no Free Route traffic available for French airspace. Currently French airspace is not a Free route Airspace, thus there is no live data available to feed the exercise. It means that scenarios are completely reflecting the current operational situation, under a route structure. There is no expected impact on the level of significance;

- The exercise is based on real traffic; the operational situations to face during the exercise cannot be anticipated. All situations would not be covered because not encountered;

- Another potential limitation could come from the support decision tool, not allowing or partially allowing some configuration assessment (due to real traffic the number of proposed sector configurations is limited);

- The support decision tool does not include all the information currently used by FMP and Supervisors (information within CHMI or SALTO, like simulation of regulation or STAM). Some functionalities, like the recording of the chosen configuration for monitoring purpose, is missing. It is possible that it can affect the performance of participants in the exercise;

- The initial assessment of the feasibility and usability of the support decision tool may be not fully representative and significant from a statistical point of view but it will provide a reasonable tendency. Given these limitations, all the conclusions on the feasibility and usability of such tool have to be treated as preliminary and are subject to change.

5.5.7 Validation Exercise Platform / Tool and Validation Technique

5.5.7.1 Validation Exercise Platform / Tool characteristics

V&V Platform Name		SINAPS
A.1.1	It is a new developed V&V platform?	Yes. Based on results of the SESAR I PJ-07.05.04-EXE-0755 exercise, the pursued objective in this project is the operational evaluation by Supervisors and FMPs of new functionalities to better adapt opening schemes to the traffic demand.
A.1.2	If yes, which are the reasons supporting the development of a new platform?	Three reasons supported the development of this new platform: - The evaluation of new functionalities : real time multi-objectives optimization algorithm ; data mining technics to learn from the past, and some decision support functions to choose the most appropriate solutions; - the proposition of some requirements for the decision making process in order to find adequate airspace configurations and to answer to any emerging change or new event; - a better and faster integration of the new features of SINAPS in SALTO. In fact, SINAPS is a milestone of the SALTO operational project. HMI principles of SINAPS are similar to the SALTO HMI principles and SINAPS is based on a web services architecture.
A.2	It is the first time to be used for a SESAR validation exercise	Yes the DSNA SINAPS tool used in the V&V platform has been adapted to VP-08.01-05 exercise requirements, and as it is an incremental process, some new features can be later implemented.
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	NO As mentioned above the platform has been specifically developed for VP-08.01-05. Nevertheless, as it is an incremental process, some new features can be later implemented.
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	Airspace configuration, adaptation of the opening schemes to the traffic demand, decision making support tool, operational feasibility/usability
C	Which validation needs are going to be supported by the new	Performance assessment of DAC and the operational feasibility of using a decision support tool for the

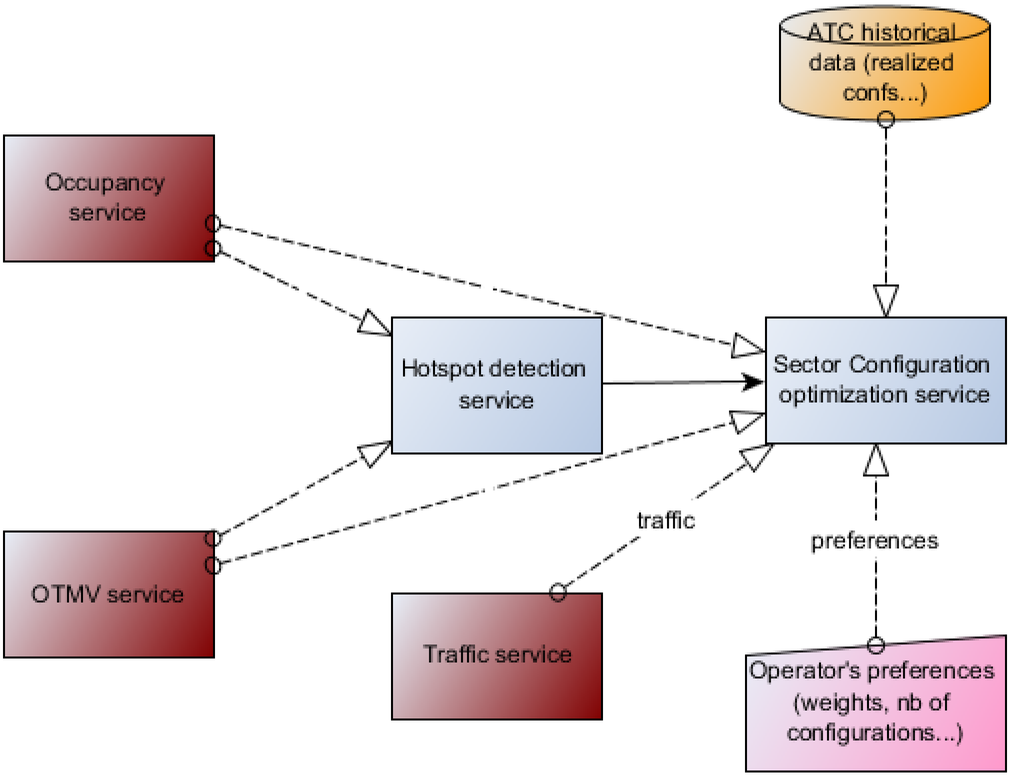
	platform (not covered by the existing platforms)?	optimization of sector configuration and ATC opening scheme.
D	Which validation methods can be used on the new V&V Platform?	Fast Time simulation Shadow mode

Table 111: Validation Exercise Platform / Tool characteristics

5.5.7.2 Architectural view: mapping Validation Infrastructure and SUTs onto EATMA

The SINAPS platform, which has been developed by DSNA/ONERA, will be used for exercise #5 trials with Bordeaux ACC.

This platform is a set of services constituting a DAC decision support tool provided to the FMP (LTM) and Supervisor for the INAP horizon time. The platform is based on sector configuration optimizations in a flow centric approach and focused on the working methods to facilitate further integration.



V&V Platform Name		SINAPS
B.1	Which are the ATM Domain Systems supported by the V&V Platform?	ATFCM
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation?	Cooperative Airspace Design Cooperative Airspace Management

5.5.7.3 Validation Exercise Technique

EXE-08.01-V2-VALP-005 will use Fast-Time simulation, and Shadow Mode techniques in order to collect quantitative and qualitative data and cover the validation objectives.

Site of the exercise

The validation exercise will take place at the French Bordeaux ACC.

5.5.8 Analysis Specification

5.5.8.1 Data collection methods

This section provides an overview of the data collection methods to obtain the data which will be used in the post-execution activities to calculate the metrics and indicators defined for this validation exercise (Table 21). This will include both quantitative data in the form of recorded metrics which will be obtained from a script to replay data after each exercise and qualitative data which will be derived through subjective feedback obtained from the user in the form of structured questionnaires, debriefings and general observations.

Exercise Validation Objective	METRICS/KPI	Data collection method
EX5-OBJ-08.01-V2-VALP-PE1-002	**PRD6**: En-route variability Unit: Minutes Calculation: Total gain of the minutes of delay	**Quantitative (output from a script to replay data)**
	Operators (*i.e.* Supervisors and FMPs) feedback on the possibility to identify appropriate measures	**Qualitative (Interview and expert judgement)**
EX5-OBJ-08.1-V2-VALP-PE1-003	**CEF2**: Flights per ATCO-Hour on duty Unit: Nb Calculation: Count of Flights handled divided by the number of ATCO-Hours applied by ATCOs on duty. Calculation: Total surface area of occupancy curves under sustain for a given period and the chosen configurations [26]	**Quantitative** **(output from a script to replay data)**
	CEF3: Technology costs per flight Unit : EUR / flight Calculation: G2G ANS cost changes related to technology and equipment**.**	

[26] Machine learning method associated to operational expertise can be used to determine peak/sustain of new collapsed sectors not defined.

Exercise Validation Objective	METRICS/KPI	Data collection method
EX5-OBJ-08.01-V2-VALP-PE1-004	**SAC1a (Safety):** Number of moderate and severe overloads, better workload balance Unit : Standard deviation Calculation: Total surface area of occupancy curves over peak and over sustain for a given period and the chosen configurations.	**Quantitative** **(output from a script to replay data)**
	HP 3.3 Team Situation Awareness Subjective measures: Operators (*i.e.* Supervisors and FMPs) feedback on the common situation awareness due to the implementation of an automated tool.	**Qualitative** **(Interview and expert judgement)**
EX5-OBJ-08.01-V2-VALP-PE1-005	**FEFF** Operators (*i.e.* Supervisors and FMPs) feedback on the trend to minimize the modification of trajectories	**Qualitative** **(Interview and expert judgement)**
EX5-OBJ-08.01-V2-VALP-TF1-001	Task descriptions as functional requirements Operators (*i.e.* Supervisors and FMPs) feedback on algorithms specifications	**Qualitative** **(Questionnaires and observation notes)**
EX5-OBJ-08.01-V2-VALP-TF1-002	Operators (*i.e.* Supervisors and FMPs) feedback on DAC and tool usability Identification of research prototype further requirements needs, if any.	**Qualitative** **(Interview, standardized questionnaire, expert judgement and observation notes)**
EXE5-OBJ-08.01-V2-VALP-OF1-001	Operators (*i.e.* Supervisors and FMPs) feedback on the reduction of the reaction time (*e.g.* identification of significant events) Diminution of mental and tasks workload	**Qualitative** **(Questionnaires and expert judgement)**
	HP1.3. Workload Subjective measures of the workload	
EXE5-OBJ-08.01-V2-VALP-OF1-002	**HP3.1. Roles and responsibilities** Operators (*i.e.* Supervisors and FMPs) feedback on the operational procedures and the different roles of the actors involved in the DAC process	**Qualitative** **(Interview, standardized questionnaire: Position Analysis Questionnaire, observation notes)**
EXE5-OBJ-08.01-V2-VALP-OF1-003	Operator feedback on DAC concept. Identification and requirements for working methods, if any	**Qualitative** **(Questionnaires and expert judgement)**

Exercise Validation Objective	METRICS/KPI	Data collection method
EX5-OBJ-08.01-V2-VALP-CO1-002	Operators feedback on ATFCM measures	**Questionnaires and expert judgement**

Table 112: Metrics and indicators defined for EXE-08.01-V2-VALP-005

5.5.8.2 Analysis method

The quantitative data will be recorded and logged during the exercise for a Post-ops statistical analysis. The results obtained for each simulation run will be compared as described in the Scenario description to provide evidence of the operational feasibility of The Dynamic Airspace Configuration concept.

The qualitative data provided by operational experts, will be taken into account during the post processing session and will be used in the assessment and analysis of the final results according to the operational environment of the execution of the exercise.

5.5.9 Exercise Planning and management

5.5.9.1 Activities

The activities concerning EXE-08.01-V2-VALP-005 could be divided into three different topics:

- Preparatory activities
- Execution activities
- Post-execution activities.

5.5.9.1.1 Preparatory activities

The main preparatory activities are described below:

- Definition of the exercise: high level definition of the exercise, including details such as selection of functionalities available in the validation tool, validation scenarios, in terms of airspace and traffic data, validation objectives, indicators to be measured, and data collection measures
- Preparation of the section of Validation Plan related to the exercise
- Preparation of the validation platform
- Training on the new platform (proposal of a new working method)
- Dry runs of the exercise

5.5.9.1.2 Execution activities Exercise

The main execution activities are described below:

- Run of the exercise using SINAPS platform
- Data collection of data logs, metrics and questionnaires

5.5.9.1.3 Post Exercise analysis

The main post-execution activities are described below:

- Analysis of the quantitative data collected during the execution phase by comparison of the Solution scenarios with regard to the reference ones and outline of conclusions and recommendation
- Analysis of the qualitative data provided by operational experts during the execution phase
- Elaboration of validation report

5.5.9.2 Roles & Responsibilities in the exercise

DSNA is the leader of EXE-08.01-V2-VALP-005, and is responsible for the coordination between all the partners involved in this exercise.

The main tasks are outlined as follows:

- Definition of the validation activities for the exercise as described in PJ-08 OSED (DSNA);
- Production of the exercise plan (DSNA);
- Integration of Exercise Plan in the Validation Plan (DSNA);
- Design of the validation exercise (ONERA);
- Setting up of simulation tool (ONERA);
- Planning and conduct of the validation exercise (ONERA);
- Analysis of the exercise results (DSNA & ONERA);
- Production of the exercise report (DSNA & ONERA);
- Integration of the exercise results and conclusions in the Validation Report (DSNA).

The roles and responsibilities of the staff involved in the exercise have been identified as follows:

- Exercise leader (DSNA): In charge of the preparation and planning of the exercise, including coordination with the relevant stakeholders/experts and consolidation/consistency checks of the inputs. He/she is responsible of the consolidation and production of the exercise plan and exercise report.
- Validation expert: Responsible for the definition of the exercise, integration of the exercise plan in the validation plan, analysis of results and integration of exercise report into the validation report.
- Technical expert: Responsible for the technical aspects of the exercise, ensuring workability of the platform and tools in both preparation and execution phases.
- Operational expert: Responsible for the operational definition and design of the scenarios, supporting validation expert during analysis of the results and collaborate to the production of the exercise plan and exercise report.

5.5.9.3 Time planning

EXE-08.01-V2-VALP-005 main activities will be carried out between Q3 2017 and Q4 2018 (to be defined suspended to the B2B NM Ops authorization access). The time planning of the validation exercise is shown in Table 22: Detailed time planning.

ACTIVITY	START	END
Preparatory activities (trial definition)	September 2017	April 2018
Preparatory activities (trial execution)	April 2018	September 2018
Execution activities	September 2018	November 2018
Post-Execution activities	November 2018	January 2018
Exercise Validation Report	January 2019	April 2019

Table 113: Detailed time planning

5.5.9.4 Identified Risks and mitigation actions

Some risks have been identified as susceptible to happen during the different activities that compose EXE-08.01-V2-VALP-005.

Table 23 identifies the risks for this exercise as well as their probability of occurrence, their criticality level and the proposed mitigation actions.

Risks	Impact	Probability	Mitigation Actions
Risk #01: No access to the NM Ops	5-Very high	3-Medium	Coordination between DSNA and EUROCONTROL teams to ensure the availability for the execution activities to be carried out
Risk #02: Limitations of the validation tool on the level of significance of the results.	3-Medium	2-Low	Production of specific document for technical requirements. Monthly coordination with development team (ad-hoc meeting if needed). Request for intermediate/beta release to evaluate/pre-validate evolutions and/or work-arounds.
Risk #03: Delay in delivery of specific developments.	3-High	1-Very Low	Monthly coordination with development team (ad-hoc meeting if needed).
Risk #04: The HMI does not meet the job requirement	3-High	1-Very Low	Application of the human Factors in design process

Risks	Impact	Probability	Mitigation Actions
			Several sprint design with multi-actors involved (several technical and operational experts) Several HMI tests with technical and operational experts

Table 114: Risks and mitigation actions for Validation Exercise #05

5.6 Validation Exercise 08.01-V2-VALP-006 Plan

5.6.1 Validation Exercise description and scope

EXE-08.01-V2-VALP-006 is the third validation activity planned within the framework of PJ-08 solution 01 to contribute to reach the PJ-08 V2 maturity level. It is the first validation exercise in the context of PJ08 solution 01 involving actors. This validation exercise is a preliminary evaluation of DAC concept from the ATCOs perspective. It will simulate ATCOs working within DAC approach via ATCOs CWP prototype. It's a gaming exercise through prototyping sessions. DAC configurations that will be used in exercise are based on Italy Free Route environment and generated during the exercise EXE #1. During the exercise, ATCOs will be notified about the sector change 15 minutes in advance via CWP interface. The minimum time between two sector changes will be 30 minutes. The exercise will contribute to:

- Initial operational feasibility of the DAC for the ATCOs. The main focus is on acceptance (buy-in) from ATCOs of the workability of the DAC approach for ATCO CWP
- Refinement of the OPS requirements for the CWP
- Validation of the workflow with ATCOs.

Before the start of the exercise, a master ATCO will assign the flight to the controllers. He will also assure that the traffic is consistent before and during the exercise. During the exercise, the controllers and pseudo-pilots will follow the working procedures of the Milan ACC.

EXE-08.01-V2-VALP-006 will be led by SINTEF, with ENAV providing support in collecting the requirements and conducting the exercise.

EXE-08.01-V2-VALP-006 addresses mainly OIs AOM-0809A to which is associated the enabler reported in Table 10.

SESAR Solution ID	SESAR Solution Description	Master or Contributing (M or C)	Contribution to the SESAR Solution short description	OI Steps ref. (from EATMA)	Enablers ref. (from EATMA)	*Required v Optional
SESAR Solution 08.01	Management of Dynamic Airspace Configurations	C	**Solution 08.01 focus on validation of Dynamic Airspace Configurations (DAC) and Dynamic Mobile Areas (DMAs) of types 1 and 2 in FRA that enable flexible solutions that can be dynamically adapted to traffic demand to respond to different regional/local performance objectives, which may vary in time and place up to concept maturity level 2**	**AOM-0809-A**	AAMS-19	R

**Although not required by EATMA, the project has identified the enablers that will be developed during the project's lifecycle and those which will be used during the validation activities.*

Table 115: EXE08.01.06 OIs and Enablers addressed

The operational concepts and use cases addressed by the EXE-08.01-V2-VALP-006 are defined in SESAR Solution 08.01 OSED Part I:

- Section 3.3.2.1 Dynamic Sectorisation
- Section 3.3.2.3 Use Cases:
    - UC13: ATCO situation awareness in DAC Ops environment
    - UC14: Air Traffic Control in DAC environment

5.6.2 Stakeholder's expectations and Benefit mechanisms addressed by the exercise

Stakeholder	Involvement	Why it matters to stakeholder
European Network Manager	Supporting function. Q/A	The wish for validity and relevance of the exercise and its results. The wish to ensure high quality of the delivered documents.
ANSP/ENAV	Participate in the exercise. Contribute to requirements analysis, definition of the validation scenarios and the execution of the exercise; provider of ATM expertise.	Wish to assess acceptance of the DAC approach by ATCOs and the workability of this approach for ATCO CWP Need to ensure that the roles and responsibilities of the ATCO's with regard to concept are clearly defined. Want to evaluate that the appropriate CWP and working procedures are provided.
Airspace Users	No direct involvement in the exercise.	
Military Airspace Users	No direct involvement in the exercise	
European Commission	Direct participation through SJU. Participate at the Visitors Day	The EC is interested in the acceptability of DAC approach

Table 116: Stakeholders' expectations

Feature	Impact Area	Indicators	Positive or negative impacts	KPI/KPA/TA

Figure 72. Benefit mechanism diagram (adapted from SPR-INTEROP/ OSED [38])

The benefit mechanism identified for the concept improvement [38] targeted by the exercise are marked on the figure below by red circles. It should be noted that the green arrow with a star is used to highlight two opposite effects on the workload caused by the dynamicity of the configurations. The first effect is the reduction of the workload caused by the optimisation of the sector configurations for the given traffic complexity. The second is the possible increase of the workload due to the additional effort required by the ATCO to build his mental picture of the traffic situation after any reconfiguration announcement and change.

5.6.3 Validation objectives

SESAR Solution Validation Objective	SESAR Solution Success criteria	Coverage and comments on the coverage of SESAR Solution Validation Objective in Exercise 006	Exercise Validation Objective	Exercise Success criteria
OBJ-08.01-V2-VALP-PE1	CRT-08.01-V2-VALP-PE1-003	Limited to the en-route ATCOs . DMA are not studied in the EXE	EX6-OBJ-08.01-V2-VALP-PE1-003 To determine if the cost efficiency is increased when ATCOs using CWP on optimised airspace configurations.	EX6-CRT-08.01-V2-VALP-PE1-003 EXE06 provides the evidence that DAC approach increases the Cost Efficiency of the flight per ATCO hours
OBJ-08.01-V2-VALP-PE1	CRT-08.01-V2-VALP-PE1-004	Limited by the functionality of ATCO CWP prototype; no support for conflict detection DMA are not studied in the EXE	EX6-OBJ-08.01-V2-VALP-PE1-004 To assess if safety remains the same.	EX6-CRT-08.01-V2-VALP-PE1-004 EXE6 provides the evidence that DAC approach maintains the current level of Safety
OBJ-08.01-V2-VALP-TF1	CRT-08.01-V2-VALP-TF1-003	Limited to En route ATCO only. DMA are not covered in the EXE;	EX6-OBJ-08.01-V2-VALP-TF1-003 To assess the usability of the ATCO CWP for managing changes of sectorisations	CRT-08.01-V2-VALP-TF1-003 EXE6 provides evidence of the usability of ATCO CWP with DAC approach
OBJ-08.01-V2-VALP-C01	CRT-08.01-V2-VALP-CO1-001		EX6-OBJ-08.01-V2-VALP-C01-001	EX6-CRT-08.01-V2-VALP-CO1-001

			To assess the operational feasibility of DAC in Free Route Airspace	Solution 08.01 provides evidence of Operational feasibility of the concept when it is integrated into the in the Free-Route environment
OBJ-08.01-V2-VALP-OF1	CRT-08.01-V2-VALP-OF1-001	Limited to the role of ATCO . DMA are not studied in the EXE		EX6-CRT-08.01-V2-VALP-OF1-001 EXE06 provides the evidence on ATCOs capability to successfully accomplish tasks and meet job requirements when sectorisation changes
	CRT-08.01-V2-VALP-OF1-003	Limited to ATCOs. DMA are not studied in the EXE		EX6-CRT-08.01-V2-VALP-OF1-003 EXE6 provides evidence of good rate of ATCO acceptability

Table 117: Validation Objectives addressed in Validation Exercise 6

As defined in the Table above, the objectives are only partly covered as first this exercise is limited to the ATCO part, no planning phase, there is no DMA and for most of the OBJ, only some criteria will be assessed.

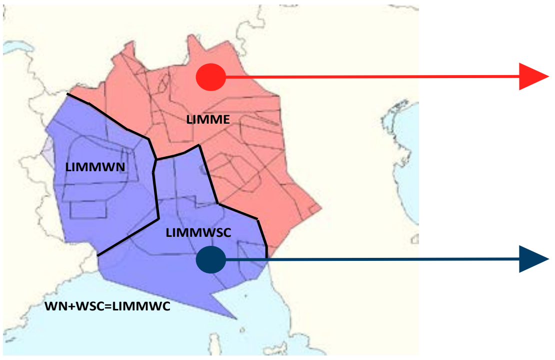
5.6.4 Validation scenarios

The exercise aims to perform an initial evaluation of operational feasibility of the DAC for the ATCOs. This will be done by comparing two working conditions for ATCOs:

- Reference scenario (Condition_1). It simulates ATCOs and pseudo-pilots working within static approach. There are no sector changes during the exercise.
- Solution scenario (Condition_2). It simulates ATCOs working within DAC approach via ATCOs CWP prototype. During the exercise, ATCOs will be notified about the sector change 15 minutes in advance via CWP interface. The minimum time between two sector changes will be 30 minutes.

Sector configurations and the traffic data for both reference and solutions scenarios are prepared by PJ08 EXE08.01.01 and based on Run 16. Export files with opening scheme are delivered by ENAV. All the details about these data sets, and the process of generating opening schema including balancing ATCOs usage with overloads is described in Section 5.5.4.

The validation scenarios to be studied in the PJ08 EXE08.01.06 have been defined to validate Dynamic Airspace Configuration concept on the LIMM West and East sectors of Milan ACC airspace and in a Free Route environment.



CWP name	Airspace name	FLs
EN6	LIMME6	365-UNL
ES5	LIMME5	335-365
EN4	LIMME4	305-335

CWP name	Airspace name	FLs
WN6	LIMMWC6	365-UNL
WS5	LIMMWSC5	335-365
WN5	LIMMWN5	335-365
WN4	LIMMWC4	305-335

Figure 73: Sectors used in EXE 8.1.6; Italy free route FL 335-UNL

Domain experts from ENAV selected two subsets of opening scheme (opening scheme windows) from EXE#1 RUN16 satisfying the following requirements of the exercise:

- The time between two configurations is minimum 30 minutes
- The total length of a session is about 60 minutes
- Changes of sectors are of medium complexity

- Both horizontal and vertical changes are included.

Sector configurations from these data sets are the configurations of the solution scenarios. A sector configuration used in a reference scenario is simply the first configuration of the corresponding solution scenario.

Traffic information was provided by EXE#1 (see in Section 5.5.4. for the details).

The exercise consists of six sessions (three with reference scenarios and three with solution scenarios).

5.6.4.1 Reference scenarios

In a reference scenario ATCOs and pseudo-pilots work with static approach. There are no changes of sectors during the exercise. ATCOs CWP is similar to the one they are used to from Milan ACC. Figure below presents ATCOs CWP for the reference scenario.

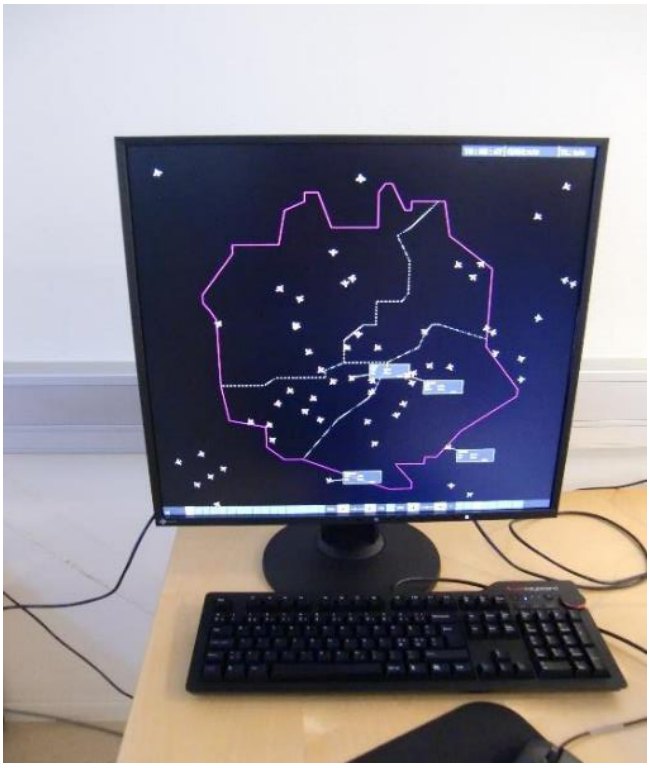


Figure 74. ATCOs CWP for Reference scenarios

A reference scenario uses the first sector configuration that appear in the selected opening scheme window. The following reference scenarios are used in EXE#6.

Scenario	General Description

SCN-08.01.06-VALP-0003-R1	**Reference Scenario** for the first opening scheme window. EXE#1RUN 16. No changes of sectors (the first configuration is used). Traffic: 18 June 2023 from 9:10 to 10:10
SCN-08.01.06-VALP-0003-R2	**Reference Scenario** for the first opening scheme window. EXE#1RUN 16. No changes of sectors (the first configuration is used). Traffic: 18 June 2013 from 10:10 to 11:10

The sectorisation remains the same during the whole session. This give the following layout for a reference scenario session.

	Start	End
ATCO_1	Sector A in Configuration 1	
ATCO_2	Sector B in Configuration 1	
ATCO_3	Sector C in Configuration 1	
Time	0:00	1:00

5.6.4.2 Solution scenarios

Figures below gives an example on of sector change that will be used in the exercise. Sector_1 (with the white borders) will change to Sector_1'.

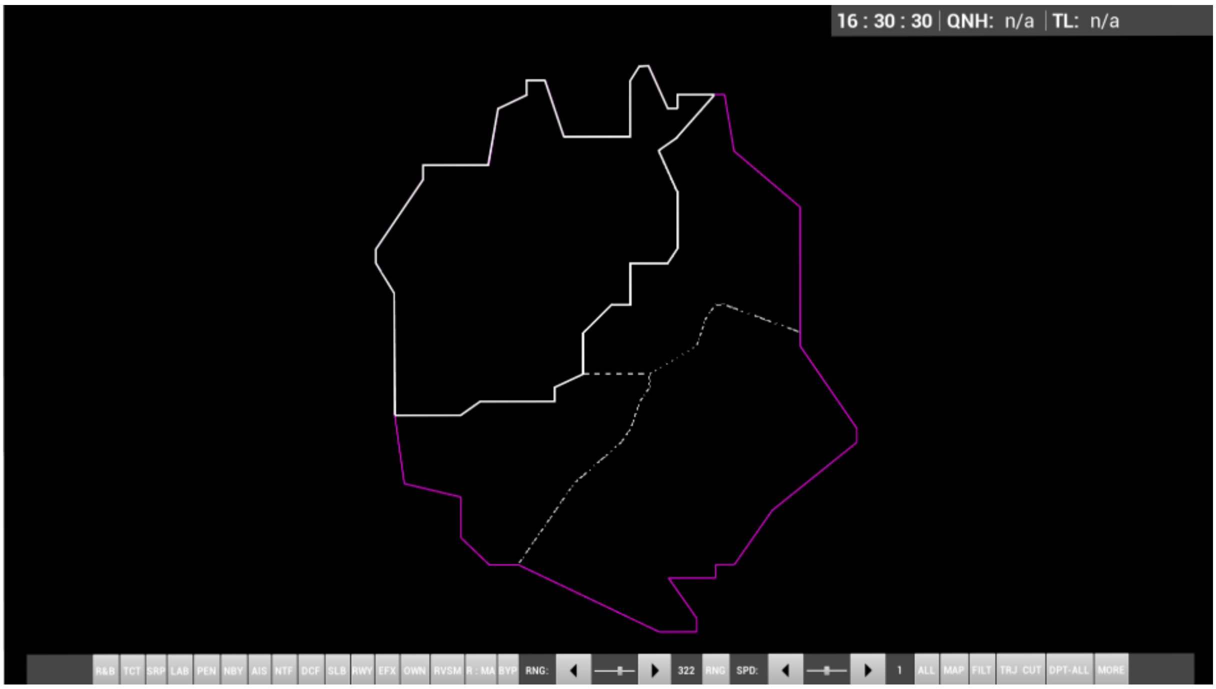


Figure 75. First configuration. Sector_1 has white borders.

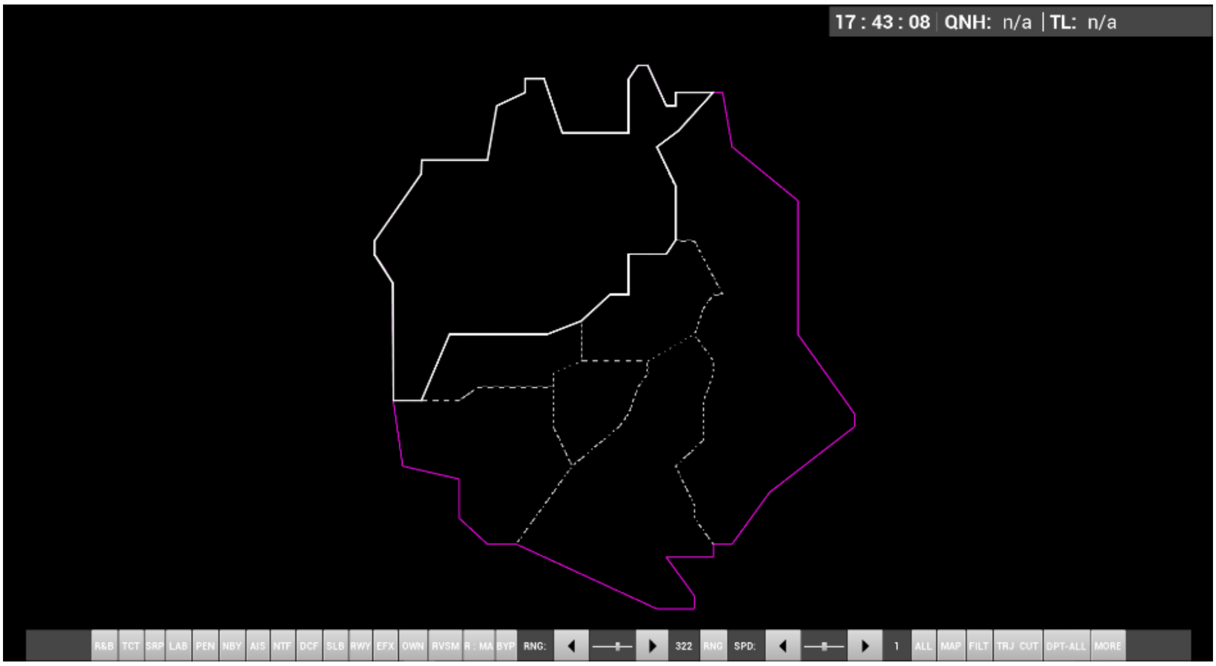


Figure 76. Second configuration. New sector - Sector_1' has white borders now.

ATCOs working with solution scenarios will in addition to radar screen have one more touch screen that will be used to present changes of sectors. Figure below presents ATCOs CWP.

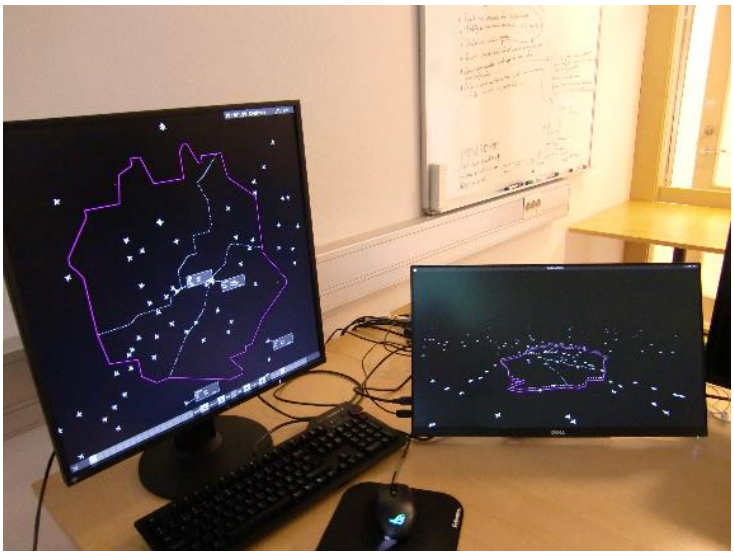


Figure 77. ATCOs CWP

In a solution scenario, there will be two airspace configuration changes during the one exercise session (20 minutes after the start and 50 minutes after the start). The following solution scenarios are used in EXE#6.

Scenario	General Description
SCN-08.01.06-VALP-0003-S1	**Solution scenario** for the first opening scheme window. EXE#1RUN 16. Sector configurations change. Traffic: 18 June 2023 from 9:10 to 10:10
SCN-08.01.06-VALP-0003-S2	**Solution scenario** for the first opening scheme window. EXE#1RUN 16. Sector configurations change. Traffic: 18 June 2013 from 10:10 to 11:10

The ATCO will be informed about the change 15 minutes before the change is effectuated (5 minutes after the start and 35 minutes after the start). This will give the following layout for a solution scenario session.

	Start	Notification of change	Conf. change	Notification of change	Conf. change End
ATCO1	Sector A in Conf.1		Sector A in Configuration 2		Sector A in Conf.3
ATCO2	Sector B in Conf.1		Sector B in Configuration 2		Sector B in Conf.3
ATCO3	Sector C in Conf.1		Sector C in Configuration 3		Sector C in Conf.3
Time	0:00	0:05	0:20	0:35	0:50 1:00

User Interface for ATCOs CWP – Solution scenario

Simple user interface has been developed to notify the controllers about the coming change and to present it. 15 minutes before a change a counter with a toggle button will appear in the up-right corner. The borders of the current sector are white. The borders of the Milan airspace are purple, and the borders on the neighbour sectors are dashed.

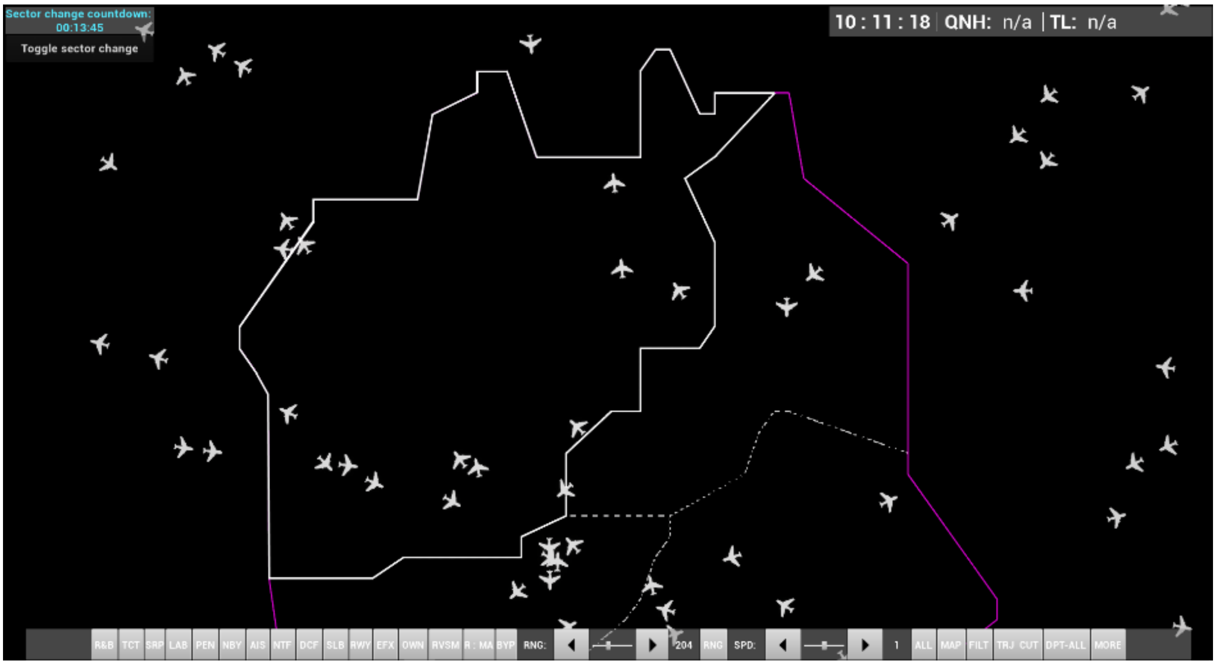


Figure 78. ATCOs CWP screen before the change of the sector

The controller can push the button to see the layout of the new sector. It will be presented in blue.

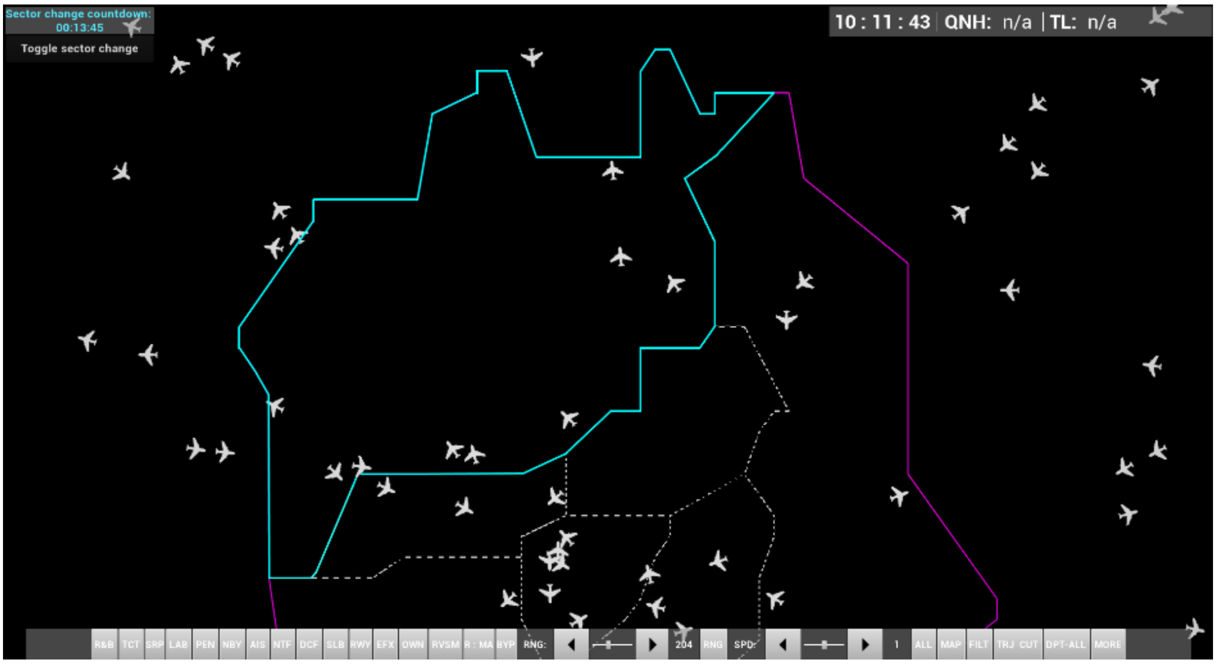


Figure 79 ATCOs CWP screen before the change of the sector, after pressing the toggle button

Vertical changes will be presented on the second screen.

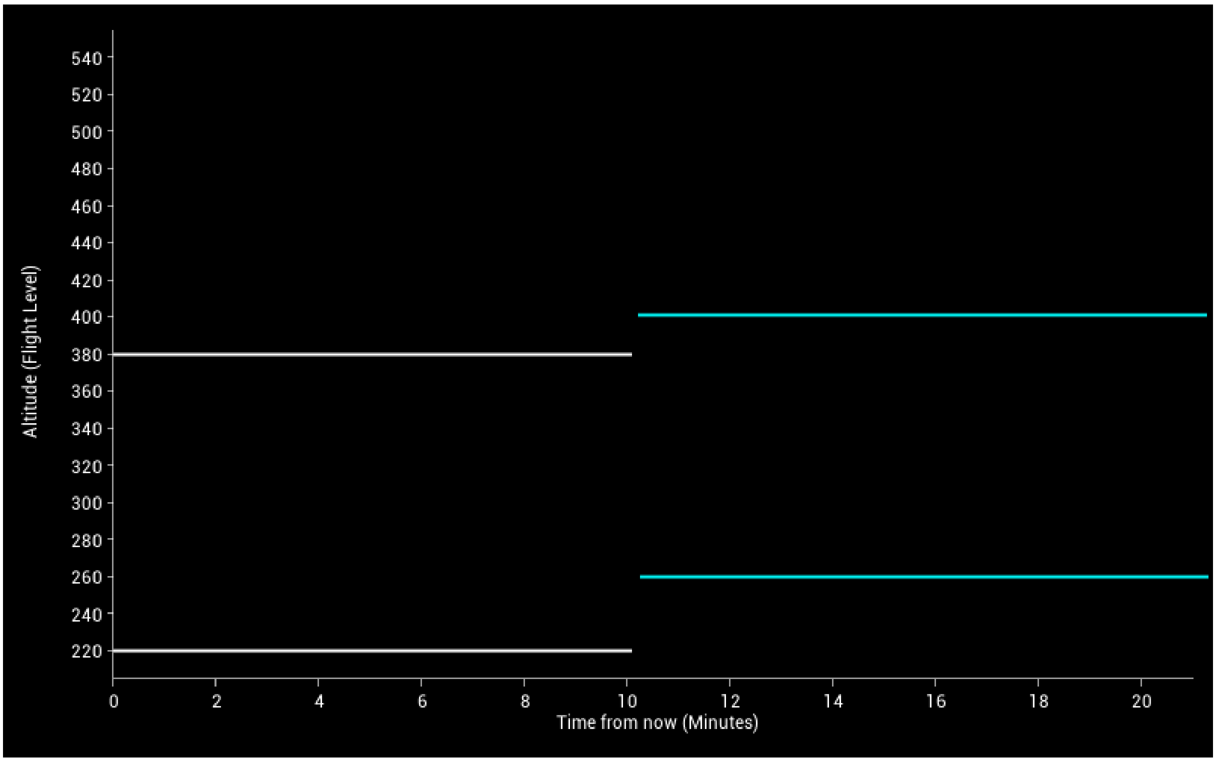


Figure 80. ATCOs CWP - the second screen presents vertical changes in blue

The controller will also be warned about the coming change regularly (10, 5 and 2 minutes) before the change. New borders will be shown on the screen in blue, blink a couple of times and disappear.

5.6.4.3 Overview of the exercise

The exercise will be conducted at ENAV premises at Ciampino. In total, six controllers and three pseudo-pilots are going to participate. ATCOs and pseudo-pilots will be placed in two different rooms.

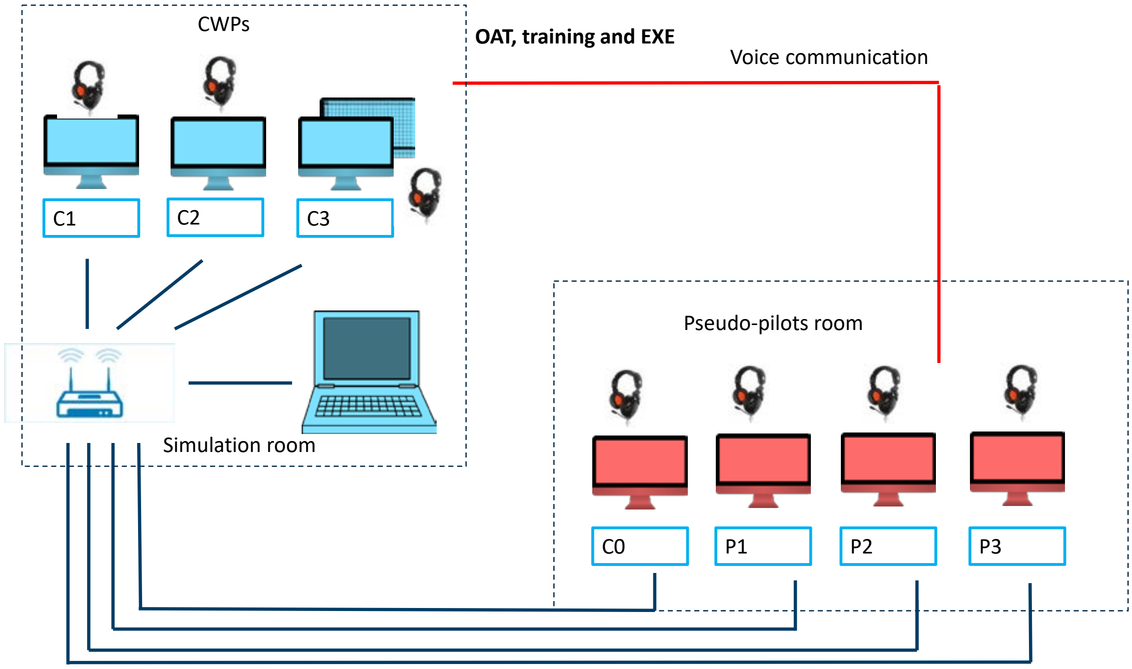


Figure 81. Layout of the exercise

To enable comparing different ATCOs controlling the same traffic in identical sectors, as well as comparing individual ATCOs controlling different sectors under the given resource limitations[27] we proposed the following exercise design. Time window X and Time window Y refers to two different opening scheme windows. Sessions 3 and Session 6 will also have a planner.

Summary of overall exercise design

	Session 1	Session 2	Session 3
Reference scenario	ATCO 1-3 Sectors A-C Time window X	ATCO 4-6 Sectors A-C Time window X	ATCO 1-3, PLN Sectors D-F Time window Y
	Session 4	**Session 5**	**Session 6**
Solution scenario	ATCO 4-6 Sectors A-C Time window X	ATCO 1-3 Sectors A-C Time window X	ATCO 4-6, PLN Sectors D-F Time window Y

[27] Two days for the EXE#6 exercise, 6 ATCOs and three pseudo-pilots available from 9:00 to 17:00.

This design will enable comparing different ATCOs controlling the same traffic in identical sectors, as well as comparing individual ATCOs controlling different sectors.

Validation scenarios are based on V2 OSED UC13 and UC14. UC13 is only partly used. A preliminary assessment reveals the following possible deviations:

- The activities of roles other than ATCO are not considered.
- ARES are not explicit in EXE#6, but may be part of the basis for the sectorization from EXE#1
- Notification is 15 min in EXE#6. In UCs 10 minutes is given as an example.
- UC13 says something which is interpreted as 30 min. notification of "serious" sectorization changes in EXE#6. Either, EXE6 will not have this type of sectorization changes, or if such changes are included, the notification will still be 15 minutes.
- The prototype in EXE#6 provides no explicit support for conflict alert
- EXE#6 will not include explicit acceptance of sectorization changes by the ATCOs

Reference and solution scenarios used in EXE#6 are summarised below.

Scenario	General Description
SCN-08.01.06-VALP-0003-R1	**Reference Scenario** for the first opening scheme window. EXE#1RUN 16. No changes of sectors (the first configuration is used). Traffic: 18 June 2023 from 9:10 to 10:10
SCN-08.01.06-VALP-0003-S1	**Solution scenario** for the first opening scheme window. EXE#1RUN 16. Sector configurations change. Traffic: 18 June 2023 from 9:10 to 10:10
SCN-08.01.06-VALP-0003-R2	**Reference Scenario** for the first opening scheme window. EXE#1RUN 16. No changes of sectors (the first configuration is used). Traffic: 18 June 2013 from 10:10 to 11:10
SCN-08.01.06-VALP-0003-S2	**Solution scenario** for the first opening scheme window. EXE#1RUN 16. Sector configurations change. Traffic: 18 June 2013 from 10:10 to 11:10

Working positions are based on the Milan ACC airspace organisations and fully described in the Section 5.1.4.1.1. The following tables gives an overview of the control working positions and sectors in the exercise. Three ATCOs are controlling sectors called NW, NE and S and the forth one (master ATCO) is controlling the rest of the traffic.

Sectors for S1 (09:10-10:10):

CONF7E (09:10-09:30)			
CWP	**Sector**	**Bottom FL**	**Top FL**
CWP_NW	LIMM_RUN16_COBOS_7S6_SECTOR_8	325	555

CWP_NE	LIMM_RUN16_COBOS_12S9_SECTOR_13	355	555
CWP_S	LIMM_RUN16_COBOS_7S7_SECTOR_6	325	555
Master	LIMM_RUN16_COBOS_10S2_SECTOR_22	205	325
Master	LIMM_RUN16_COBOS_10S3_SECTOR_13	205	355
Master	LIMM_RUN16_COBOS_7S2_SECTOR_16	205	355
Master	LIMM_RUN16_COBOS_10S3_SECTOR_17	205	325

CONF11N (09:30-10:00)			
CWP	**Sector**	**Bottom FL**	**Top FL**
CWP_NW	LIMM_RUN16_COBOS_11S10_SECTOR_20	375	555
CWP_NE	LIMM_RUN16_COBOS_12S9_SECTOR_17	355	555
CWP_S	LIMM_RUN16_COBOS_12S11_SECTOR_15	365	555
Master	LIMM_RUN16_COBOS_10S6_SECTOR_21	335	375
Master	LIMM_RUN16_COBOS_10S5_SECTOR_23	305	365
Master	LIMM_RUN16_COBOS_12S6_SECTOR_19	205	365
Master	LIMM_RUN16_COBOS_10S5_SECTOR_22	205	355
Master	LIMM_RUN16_COBOS_11S4_SECTOR_16	205	355
Master	LIMM_RUN16_COBOS_10S5_SECTOR_21	205	335
Master	LIMM_RUN16_COBOS_10S3_SECTOR_21	205	335
Master	LIMM_RUN16_COBOS_10S1_SECTOR_20	205	305

CONF10D (10:00-10:10)			
CWP	**Sector**	**Bottom FL**	**Top FL**
CWP_NW	LIMM_RUN16_COBOS_10S9_SECTOR_12	375	555
CWP_NE	LIMM_RUN16_COBOS_10S10_SECTOR_11	345	555
CWP_S	LIMM_RUN16_COBOS_10S9_SECTOR_14	365	555

Master	LIMM_RUN16_COBOS_10S7_SECTOR_19	315	375
Master	LIMM_RUN16_COBOS_10S6_SECTOR_19	315	375
Master	LIMM_RUN16_COBOS_10S5_SECTOR_19	315	365
Master	LIMM_RUN16_COBOS_10S4_SECTOR_17	205	345
Master	LIMM_RUN16_COBOS_10S3_SECTOR_19	205	315
Master	LIMM_RUN16_COBOS_10S2_SECTOR_19	205	315
Master	LIMM_RUN16_COBOS_10S1_SECTOR_18	205	315

Sectors for S2 (10:10-11:10):

CONF10D (10:10-10:30)			
CWP	**Sector**	**Bottom FL**	**Top FL**
CWP_NW	LIMM_RUN16_COBOS_10S9_SECTOR_12	375	555
CWP_NE	LIMM_RUN16_COBOS_10S10_SECTOR_11	345	555
CWP_S	LIMM_RUN16_COBOS_10S9_SECTOR_14	365	555
Master	LIMM_RUN16_COBOS_10S7_SECTOR_19	315	375
Master	LIMM_RUN16_COBOS_10S6_SECTOR_19	315	375
Master	LIMM_RUN16_COBOS_10S5_SECTOR_19	315	365
Master	LIMM_RUN16_COBOS_10S4_SECTOR_17	205	345
Master	LIMM_RUN16_COBOS_10S3_SECTOR_19	205	315
Master	LIMM_RUN16_COBOS_10S2_SECTOR_19	205	315
Master	LIMM_RUN16_COBOS_10S1_SECTOR_18	205	315

CONF12E (10:30-11:00)			
CWP	**Sector**	**Bottom FL**	**Top FL**
CWP_NW	LIMM_RUN16_COBOS_11S10_SECTOR_16	365	555
CWP_NE	LIMM_RUN16_COBOS_11S9_SECTOR_17	345	555

CWP_S	LIMM_RUN16_COBOS_12S11_SECTOR_11	345	555
Master	LIMM_RUN16_COBOS_12S12_SECTOR_10	345	555
Master	LIMM_RUN16_COBOS_12S8_SECTOR_17	325	365
Master	LIMM_RUN16_COBOS_12S7_SECTOR_18	285	345
Master	LIMM_RUN16_COBOS_11S3_SECTOR_17	205	285
Master	LIMM_RUN16_COBOS_12S5_SECTOR_16	285	345
Master	LIMM_RUN16_COBOS_11S2_SECTOR_16	205	285
Master	LIMM_RUN16_COBOS_12S3_SECTOR_16	285	345
Master	LIMM_RUN16_COBOS_12S2_SECTOR_18	285	325

ICO_CONF12U (11:00-11:10)			
CWP	**Sector**	**Bottom FL**	**Top FL**
CWP_NW	LIMM_RUN16_COBOS_7S6_SECTOR_8	325	555
CWP_NE	LIMM_RUN16_COBOS_10S7_SECTOR_16	365	555
CWP_S	LIMR16WS_315_555_CS	315	555
Master	LIMM_RUN16_COBOS_10S6_SECTOR_18	345	365
Master	LIMM_RUN16_COBOS_13S3_SECTOR_14	285	345
Master	LIMM_RUN16_COBOS_12S1_SECTOR_14	205	285
Master	LIMM_RUN16_COBOS_10S4_SECTOR_17	205	345
Master	LIMM_RUN16_COBOS_11S5_SECTOR_16	285	345
Master	LIMM_RUN16_COBOS_11S3_SECTOR_17	205	285
Master	LIMM_RUN16_COBOS_14S4_SECTOR_14	205	315
Master	LIMR16CSW_205_285	205	285
Master	LIMM_RUN16_COBOS_14S2_SECTOR_15	285	325

5.6.5 Exercise Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
PJ08 - Exe 6-A#1	Sectorisations used in the exercise are representative and appropriate	Airspace Layout	Sectorisations are selected by expert judgement from the set of data generated in EXE#1.		Execution	CAP	PJ.08-01		PJ.08-01	Medium
PJ08 - A#3	Traffic sample used in the exercise is appropriate	Traffic Layout	Traffic sample is generated for EXE#1 by domain experts		Execution	CAP	PJ.08-01		PJ.08-01	Medium
PJ08 - EXE 6-A#2	Usability of control working positions for ATCOs is good	CWP Interface	CWP interfaces are developed for this exercise and judged by UI experts before the exercise		Execution	CAP HP	PJ.08.01.06		PJ.08-01	Medium

Table 118: Validation Exercise Assumptions

5.6.6 Limitations and impact on the level of Significance

The potential limitations of this exercise are:

- Limitations of the tool used in exercise. Interfaces for Control Working Positions for ATCOs and pseudo-pilots do not include the full functionality of the future CWP that will be used with the DAC approach. The requirements for the tool are still under development. Some current functionality, like support for conflict detection is missing. It is possible that this affects the performance of the participants in the exercise.

- Limitations of the number and type of changes that will be used in the exercise. During the exercise the participants will be exposed in total to two different sets of changes in Condition_2. The data sets used in the exercise are selected by the experts to include both vertical and horizontal sector change of medium complexity. However, the results might be different for other changes

5.6.7 Validation Exercise Platform / Tool and Validation Technique

5.6.7.1 Validation Exercise Platform / Tool characteristics

SIMADES (SINTEF Multi-Agent Discrete Event Simulator) is a simulator developed at SINTEF(NATMIG) to enable fast-time and real-time, human-in-the-loop simulation studies, prototyping sessions. It has been applied for detailed road traffic simulations and was also used in SESAR 1 to simulate different agents (Tower Control, Airplanes, Pilots, Approach Control, etc) operating in and around an airport. For this project, SIMADES will be extended to simulate en-route traffic, to cope with airspace sector configurations and to interact with Air Traffic Controllers and pseudo pilots. For the latter, SINTEF will develop new flexible Controller Working Positions (user interface) that can be connected to the SIMADES simulator. This tool will be referred as SIMADES ATC in the rest of the document.

V&V Platform Name		SIMADES ATC (SINTEF)
A.1.1	It is a new developed V&V platform?	Yes
A.1.2	If yes, which are the reasons supporting the development of a new platform?	Need for development of CWP (for ATCOs) for DAC approach. The existing simulator (SIMADES) is extended for this exercise to simulate en-route traffic, to cope with airspace sector configurations and to interact with Air Traffic Controllers.
A.2	It is the first time to be used for a SESAR validation exercise	YES. However, it was used in SESAR 1 project 10.9.2 workshops as preparation for a human-in-the-loop validation exercise.
A.3	It is used the first time in a SESAR validation exercise and it needs new features to be implemented	YES: SIMADES will be extended to simulate en-route traffic, to cope with dynamic airspace sector configurations and to interact with Air Traffic Controllers.
B	Which operational scenarios / improvements/etc. (general) can be validated on the new V&V Platform?	ATCOs working in the Dynamic Airspace Configurations environment
C	Which validation needs are going to be supported by the new platform (not covered by the existing platforms)?	The addition of Controller Working Positions with different ways to visualize changing sector configurations is a new feature.
D	Which validation methods can be used on the new V&V Platform?	Validation by gaming exercise

Table 119: Validation Exercise Platform / Tool characteristics

5.6.7.2 Architectural view: mapping Validation Infrastructure and SUTs onto EATMA

V&V Platform Name		*SIMADES (SINTEF Multi-Agent Discrete Event Simulator)*
B.1	Which are the ATM Domain Systems supported by the V&V Platform? •	• En-Route / ATC • Centre (WOC)
B.2	Which functional blocks of the IBP will be provided and/or needed to support the operational concepts validation? Following functional blocks (FB) will be provided to support the operational concept validation: •	• Cooperative Airspace Management

Table 120: Validation Exercise Platform / Tool mapping onto EATMA

5.6.7.3 Validation Exercise Technique

This exercise is conducted as a set of gaming sessions where six air traffic controllers are subjected to work scenarios that are played out in real-time using the SIMADES ATC tool at the ENAV premises at Rome Ciampino. During the simulation exercises, the facilitators gathered qualitative and quantitative data, allowing for a detailed analysis and understanding of the workability of the DAC approach for ATCO.

The controllers will work with both static approach (Condition_1 – the controllers work with only one sectorisation during a session), and with DAC approach (Conditions_2 – the controller work with DAC approach; a change of sector is notified 15 minutes in advance and minimum time between two changes is 30 minutes). We will have in total six sessions: three with Condition_1 and three with Condition_2. Each session will last two hours and include the introduction, run (60 minutes) and a post-run debriefing with interview and questionnaires.

This is the appropriate technique for preliminary assessment of acceptance. It will allow collecting a rich data set enabling us not only measuring potential effects of DAC approach on human performance, but also understanding potential problems and issues.

5.6.8 Analysis Specification

5.6.8.1 Data collection methods

The following data will be collected during the exercise:

- Direct "over the shoulder" observations of ATCOs

- Video/audio records of the exercise (focus on the screens/keyboards)
- ATCOs descriptive feedback (interviews after each session; open-ended questions)
- Questionnaires used for the subjective assessment of DAC approach acceptability, usability of the procedures and CWP
- Questionnaires used for the subjective assessment of workload and situation awareness
- Logfiles – the simulator logs interaction between ATCOs and pilots, positions of the plane (latitude, longitude, attitude), speed and bearing; UI logs
- Audio recording of the voice communication between ATCOs and pseudo-pilots

Data triangulation will be applied. If, for example, an event was observed by the observers (registered in the observer notes) it will be checked for confirmation or additional explanations in log files and video records. Qualitative data will be transcribed and coded (emergent coding for the interviews, a priory coding for communication logs).

The following table gives an overview of the data collection methods.

Exercise Validation Objective	METRICS/KPI	Data collection method
EX6-OBJ-08.01-V2-VALP-PE1-003	**CEF2** Number of planes managed by a controller per hour Calculation: A plane is considered to be managed by an ATCO from the moment it is assumed by the ATCO to the moment it is assumed by the next one. Coding of the transcripts.	**Voice communication logs**
EX6-OBJ-08.01-V2-VALP-PE1-004	**SAFETY** Number of conflict detection/resolution situations identified in the log files Calculation: Based on the given separation rules one analyses the log files and identifies situations where two planes need conflict resolution	**SIMADES log files**
EX6-OBJ-08.01-V2-VALP-TF1-003	Monitoring sector configuration changes Controllers feedback on acceptability and usability of the provided support for monitoring with DAC approach	**Questionnaire**
EX6-OBJ-08.01-V2-VALP-CO1-001	Controllers feedback on operational feasibility of the concept integrated in free-route environment.	**Interview**

Exercise Validation Objective	METRICS/KPI	Data collection method
	HP1.2 Workload[28] (workload per position and workload distribution) Number of clicks per hour	**SIMADES UI log files**
	HP1.2 Workload Subjective measures of the workload	**Questionnaire and interviews**
	HP1.3 Human error Number, type and severity of self-reported and observed errors/problems (all type of problems: DAC approach, procedures, sectors)	**Interviews and observation notes**
	HP2.3 User interface acceptability ATCOs feedback on UI usability Identification of needs for improvements, if any Usability of the CWPs interface (feedback from the interviews, a questionnaire)	**Interviews and questionnaire**
	HP4.1 Communication burden and situation awareness Number and type of messages between ATCOs and pseudo-pilots (analysis to be done per role). Coding schema by Harville et al.[39] will be extended with codes for conflict resolution and deviations	**Voice communication logs and questionnaires**
	HP4.1 Communication burden and situation awareness Situation awareness	**Questionnaire**

[28] The exercise is explorative. Several alternatives for measuring workload are suggested like deviation from the planned route and deviation of the planned speed. It might be that it would not be necessary to analyse all of them.

Exercise Validation Objective	METRICS/KPI	Data collection method
	HP4.1 Technology acceptance ATCOs feedback on the acceptance of the DAC approach and the procedures Identification of needs for improvements, if any	**Interviews**

5.6.8.2 Analysis method

The aim of the exercise is to do the preliminary evaluation of the DAC concept from the ATCOs perspective. Data analysis will be process by the data cleaning and preparation. The data cleaning and preparation will consist of the following steps:

- Making transcription and the summary of qualitative data (interviews, communication logs, answers to open-ended question in questionnaires, observer notes)
- Checking the log files for potential errors and irregularities
- Cross-checking of the data from different data sources against each other
- Generating planned and actual trajectories

Data analysis will consist of the following steps:

- Coding of the qualitative data
- Extracting the quantitative measure from the log files and questionnaires
- Analysis of the qualitive and quantitative data by the means of descriptive statistics.

The exercise is not designed to test if there is a statistically significant difference between two conditions (static and dynamic approach), but descriptive statistics might reveal differences in two approaches. During the first 20 minutes of an exercise session, the controllers are working in the exactly same conditions (sector configurations, traffic) with the only difference being that the controllers working with the DAC approach are notified several times from minute 5 to minute 20 that the sector configurations are going to change. The analysis of the qualitative and quantitate data will investigate what are the effects of these notifications. During the next period of the session (minutes 21 to 50) one group of the controllers continues to work on the same sector configuration, but another group (DAC approach) works on another sector configuration which is generated by DAC. The traffic is the same in both cases. The analysis of the qualitative and quantitate data for this period will investigate what is the total effect of the sector change. There are two possible opposite effects on the workload caused by the dynamicity of the configurations. The first effect is the reduction of the workload caused by the optimisation of the sector configurations for the given traffic complexity. The second is the possible increase of the workload due to the additional effort required by the ATCO to build his mental picture of the traffic situation after any reconfiguration announcement and change. A domain expert checked that the sector configurations used in the exercise are appropriate.

5.6.9 Exercise Planning and management

The exercise activities will be conducted at the ENAV premises at Rome Ciampino. SINTEF is in charge of deploying the simulator and control working positions for the exercise, whereas ENAV provides ATCOs and pseudo-pilots.

5.6.9.1 Activities

The activities concerning EXE08.01.06 could be divided into three groups:

- Preparatory activities
- Execution activities
- Post-execution activities.

5.6.9.1.1 Preparatory activities

The main preparatory activities are described below:

- Preparation of the technical platform for the exercise (requirement and development of HMI for CWP; development of SIMADES ATC - updating of SIMADES with new functionality and with interfaces for ATCO working positions
- Integration and testing of the platform (Definition of the exercise: high level definition of the exercise, including details such as selection of functionalities available in the validation tool, validation scenarios in terms of airspace and traffic data, frequency of changes of airspace configurations, validation objectives, indicators to be measured, and data collection measures
- Preparation of the section of Validation Plan related to the exercise
- Preparation of the training material and questionnaires
- Operational acceptance test

Pre-OAT, OAT and training

During the pre-OAT, and the preliminary training session we are going to do a sequential hand-on testing of the scenarios to be used in the main exercise. The controllers and pseudo-pilots will first be given an introduction to the DAC approach, new sectors (the starting configuration) and the interface (functionality). One controller will take the role of the pseudo-pilot, and in the next session they will change their roles. Two observers from SINTEF will closely observe them working (notes and audio-records), asking questions and give explanations if needed. They will be briefly interviewed at the end.

A detailed plan for the pre-OAT, training and OAT is given in Section 5.6.9.4.

During OAT and training, we are going to use the same procedure as in in pre-OAT by with six ATCOs and three pseudo-pilots.

5.6.9.1.2 Execution activities

The main execution activities are described below:

- Training
- Run of the exercise using SIMADES ATC (SINTEF Multi-Agent Discrete Event Simulator) with HCI for CWP
- Data collection of data logs, metrics and questionnaires

Six controllers and three pseudo-pilots from ENAV are going to participate at OAT, training and the main exercise. Operational acceptance test and training will be conducted 7th-8th of May.

The main exercise will be conducted from 9th to 10th of May. The first day will be dedicated to the Condition_1 and the second day to the Condition_2.

A detailed plan for the execution activities is given in the Section 5.6.9.3.

5.6.9.1.3 Post Exercise analysis

The main post-execution activities are described below: Analysis of the quantitative data collected during the execution phase by comparison of the solution scenarios with the reference scenario, outlining of conclusions and recommendation

- Analysis of the qualitative data collected during the execution phase
- Elaboration of the validation report.

5.6.9.2 Roles & Responsibilities in the exercise

SINTEF is the leader of EXE08.01.06, and is responsible for the coordination between all partners involved in this exercise.

The main tasks in which SINTEF is involved in this validation activity are the following:

- Requirement analysis for CWP HMI and the development of CWP HMI
- Updating the traffic simulator (SIMADES) to work with HMI
- Definition of the validation exercise plan
- Elaboration of the section of Validation Plan related to the exercise
- Exercise preparation and execution
- Post-processing of the outputs
- Analysis of the exercise results
- Elaboration of the section of Validation Report related to the exercise
- Generic input to the technical specification based on EXE

The main tasks in which ENAV is involved in this validation activity are the following:

- Support to the development of requirements for the mock-up
- Provision of ATCOs for requirement collection
- Support for definition of VALP operational scenarios
- Organise ATCOs training
- Enabling the run of the exercise at ENAV premises and provision of ATCOs for the exercise

5.6.9.3 Time planning

EXE08.01.06 main activities will be carried out between Q3 2017 and Q3 2018. Some preparatory activities (requirement analysis and development of the CWP) started already in Q1 2017.

Activity	Start	End

Preparatory activities	2/1/2017	7/5/2018
Integration activities	10/4/2018	10/4/2018
Technical acceptance test	11/4/2018	11/4/2018
Pre-operational acceptance test session with two ATCOs	12/4/2018	12/4/2018
Experimental plan and training material sent to ENAV	27/4/2018	27/4/2018
Operational acceptance test (6 ATCOs and 3 pseudo-pilots)	7/5/2018	7/5/2018
Availability note delivered	9/5/2018	9/5/2018
Execution activities	8/5/2018	11/5/2018
Training (6 ATCOs and 3 pseudo-pilots)	8/5/2018	8/5/2018
Exercise	9/5/2018	10/5/2018
Post-execution activities[29]	22/5/2018	12/6/2018
Exercise validation report	15/6/2018	31/8/2018

Table 121: Detailed time planning

Pre-OAT and Training

The integration and TAT are planned for 10th and 11th of April from 9:00 to 17:00. Details for pre-OAT and training are given below.

Pre-OAT and Training 12th of April 2018	
8:30-9:00	Preparation
9:00-9:30	Introduction
9:30-10:10	Hands-on Session_1 (Condition_1, Data_set_1, ATCO: Controller_1, pseudo-pilot: Controller_2)
10:10-10:15	Break
10:15 – 10:55	Hands-on Session_2 (Condition_1, Data_set_2, ATCO: Controller_2, pseudo-pilot: Controller_1)

[29] Preliminary results to be presented at PJ08 F2F meeting 13-14 of June 2018 in Warsaw

10:55 – 11:15	Coffee-break
11:15 – 11:55	Hands-on Session_3 (Condition_2, Data_set_3, ATCO: Controller_1, pseudo-pilot: Controller_2)
11:55-13:00	Lunch
13:00-13:40	Hands-on Session_4 (Condition_2, Data_set_3, ATCO: Controller_2, pseudo-pilot: Controller_1)
13:40-13:45	Break
13:45-14:25	Hands-on Session_5 (Condition_2, Data_set_3 ATCO: Controller_1, pseudo-pilot: Controller_2)
14:25-14:45	Coffee-break
14:45-15:25	Hands-on Session_6 (Condition_2, Data_set_3 ATCO: Controller_2, pseudo-pilot: Controller_1)
15:25-16:00	SINTEF packs the equipment

OAT, training and the main exercise

Operational acceptance test and training will be conducted 7th-8th of May from 9:00 -17:00. Activities involving the controllers starts 13:00 on 7th of May.

The main exercise will be conducted from 9th to 10th of May. The first day will be dedicated to the static approach and the second day to the dynamic. The second day will be organised the Visitors Day where visitors from SJU, ENAV and the other project partners will be able to follow the exercise. The time tables for the main exercise are given below.

9th of May (Day 1)	
Time	Activity
8:00-9:00	Preparation,
9:00-11:00	Session 1 – ATCO 1-3, ATCO 4 acts as the master ATCO
11:00-11:15	Coffee break
11:15-13:15	Session 2 – ATCO 4-6, ATCO 1 acts as the master ATCO
13:15-14:15	Lunch
14:15-16:15	Session 3 – ATCO 1-3, ATCO 5 acts as the master ATCO, ATCO 6 acts as a planner (working together with ATCO 1)

16:15-17:00	Saving the data and similar

10th of May (Day 2)	
Time	Activity
8:00-9:00	Preparation
9:00-11:00	Session 4 – ATCO 4-6, ATCO 2 acts as the master ATCO
11:00-11:15	Coffee break
11:15-13:15	Session 5 – ATCO 1-3, ATCO 6 acts as the master ATCO
13:15-14:15	Lunch
14:15-16:15	Session 6 – ATCO 4-6, ATCO 3 acts as the master ATCO, ATCO 1 acts as a planner (working together with ATCO 4)
16:15-17:00	Saving the data and similar

During the main exercise each session consists of:

- Welcome and introduction (20 minutes, including some time for ATCOs to get an overview of the situation and master ATCO to manage the traffic)
- ATCOs working on a given scenario (60 minutes)
- Interview and questionnaires (35 minutes)
- Checking and saving the data (5 minutes)

For the main exercise we have three ATCO Control Working Positions, three Pseudo-Pilot Working Positions and one master ATCO (controlling the flights prior to the start of the exercise, assuring that the traffic is consistent). As we have available six ATCOs and three pseudo-pilots, one ATCO will act as a master, and one will act as planner (Session_3 and Session_6).

5.6.9.4 Identified Risks and mitigation actions

Some risks have been identified as susceptible to happen during the different activities that compose EXE081.01.06. Table 122 identifies the risks for this exercise, their probability of occurrence and the proposed mitigation actions.

Risks	Impact (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High)	Probability (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High)	Mitigation Actions

Limitations of the CWP prototype and the simulator	3-Medium	3-Medium	Allocating enough resources for CPW development. Involvement of ENAV ATCOs in the prototype development to identify most important functionality
Risk 2 Availability of the controllers	5-Very High	1-Very Low	Early planning with ENAV

Table 122: Risks and mitigation actions

[...]

6 References

6.1 Applicable Documents

Content Integration

[1] B.04.01 D138 EATMA Guidance Material

[2] EATMA Community pages

[3] SESAR ATM Lexicon

Content Development

[4] B4.2 D106 Transition Concept of Operations SESAR 2020

System and Service Development

[5] 08.01.01 D52: SWIM Foundation v2

[6] 08.01.01 D49: SWIM Compliance Criteria

[7] 08.01.03 D47: AIRM v4.1.0

[8] 08.03.10 D45: ISRM Foundation v00.08.00

[9] B.04.03 D102 SESAR Working Method on Services

[10] B.04.03 D128 ADD SESAR1

[11] B.04.05 Common Service Foundation Method

Performance Management

[12] Performance ManagementB.04.01 D108 SESAR 2020 Transition Performance Framework (Performance Framework D4.4 (2018) 01.01.00)

[13] B.04.01 D42 SESAR2020 Validation Targets for SESAR1 Step1 and for SESAR 2020 Transition (PJ19.04 D4.5 Validation Targets (2018), Edition 01.00.00, March 2018)

[14] 16.06.06-D68 Part 1 –SESAR Cost Benefit Analysis – Integrated Model

[15] 16.06.06-D51-SESAR_1 Business Case Consolidated_Deliverable-00.01.00 and CBA

[16] Method to assess cost of European ATM improvements and technologies, EUROCONTROL (2014)

[17] ATM Cost Breakdown Structure_ed02_2014

[18] Standard Inputs for EUROCONTROL Cost Benefit Analyses Edition 8.0

[19]16.06.06_D26-08 ATM CBA Quality Checklist

[20]16.06.06_D26_04_Guidelines_for_Producing_Benefit_and_Impact_Mechanisms

Validation

[21]03.00 D16 WP3 Engineering methodology

[22]Transition VALS SESAR 2020 - Consolidated deliverable with contribution from Operational Federating Projects

[23]European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010]

System Engineering

[24]SESAR Requirements and V&V guidelines

Safety

[25]SESAR, Safety Reference Material, Edition 4.0, April 2016

[26]SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016

[27]SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015

[28]SESAR, Resilience Engineering Guidance, May 2016

Human Performance

[29]16.06.05 D27 HP Reference Material D27

[30]16.04.02 D04 e-HP Repository - Release note

Environment Assessment

[31]SESAR, Environment Reference Material, alias, "Environmental impact assessment as part of the global SESAR validation", Project 16.06.03, Deliverable D26, 2014.

[32]ICAO CAEP – "Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes" document, Doc 10031.

Security

[33]16.06.02 D103 SESAR Security Ref Material Level

[34]16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[35]16.06.02 D131 Security Database Application (CTRL_S)

6.2 Reference Documents

[36]ED-78A GUIDELINES FOR APPROVAL OF THE PROVISION AND USE OF AIR TRAFFIC SERVICES SUPPORTED BY DATA COMMUNICATIONS.[30]

[37]PJ08 D2.1.020 SESAR Solution 08.01 SPR-INTEROP/OSED for V2 - Part 00.00.02 October 2018

[38]P07.05.04 D66 Dynamic Airspace Configuration Step 2 V2 Validation Report

[39] PJ19 D4.1 Performance Framework, Edition 00.01.00, July 2017

[40]Challenges of Growth 2013. Task 4: European Air Traffic in 2035. EUROCONTROL. June 2013

[41]PJ20 Methodology for the Performance Planning and Master Plan Maintenance, First Internal Deliverable sWP2.2, Dec 2017,Ed 0.13

[42]PJ19 D4.5 Validation Targets Ed 00.00.01

[43]SESAR PJ06, N/A SESAR Solution PJ06.01: Validation Plan (VALP) for V3 - Part I, Edition 00.01.00, July 2018

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Appendix A KPI Data Collection for Performance KPIs

The KPIs will be assessed in accordance with [39]. Detailled information are available in chapter 5.x.8.

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