INDUSTRIAL RESEARCH

sesar JOINT UNDERTAKING

SESAR Solution 115 SPR/INTEROP-OSED V3 - Part V - Performance Assessment Report (PAR)

D3.1.040	**PU**
Project Acronym:	**ERICA**
Grant:	**874474**
Call:	**H2020-SESAR-2019-1**
Topic:	**ENABLE RPAS INSERTION IN CONTROLLED AIRSPACE (RPAS Accommodation)**
Consortium coordinator:	**LEONARDO**
Edition date:	**22 December 2022**
Edition:	**01.00.02**
Template Edition:	**00.00.09**

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Authoring & Approval

Authors of the document

Beneficiary	Date
Thales-AVS	20/09/2020

Reviewers internal to the project

Beneficiary	Date
S115 OSED partners	20/09/2022

Reviewers external to the project

Beneficiary	Date
NA	/

Approved for submission to the S3JU By - Representatives of all beneficiaries involved in the project

Beneficiary	Date
S115 OSED partners	10/10/2022

Rejected By - Representatives of beneficiaries involved in the project

Beneficiary	Date

Document History

Edition	Date	Status	Beneficiary	Justification
00.01.00	22/04/2021	Accepted	Thales-AVS	Intermediate Performance Assessment (PAGAR campaign 2021)
00.01.01	20/09/2022	Draft Final	Thales-AVS	Final Performance Assessment (PAR) for review
01.00.00	10/10/2022	Final	Thales-AVS	Final Performance Assessment (PAR) delivered
01.00.01	14/11/2022	Final updated	Thales-AVS	Final Performance Assessment (PAR) after PJ19 Performance feedback
01.00.02	22/12/2022	Final releasd	Thales-AVS	Minor text formatting for release

ERICA

ENABLE RPAS INSERTION IN CONTROLLED AIRSPACE (RPAS ACCOMMODATION)

This Performance Assessment Report (PAR) of the is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874474 under European Union's Horizon 2020 research and innovation programme.

Abstract

This Performance Assessment Report (PAR) provides the outcomes of the key performance indicators of SESAR Project PJ.13 W2 ERICA, Solution 115 (PJ.13-W2-115) – Accommodation of IFR RPAS as General Air Traffic (GAT) in controlled airspace.

As a reminder, the solution's objective is to improve accessibility of existing/initial Medium Altitude Long Endurance Remotely Piloted Aircraft System (MALE RPAS) to access and fly transit routes in controlled class A-C airspace as General Air Traffic (GAT) under Instrument Flight Rules (IFR) with no segregation and no technical change to the ATM systems. The target is met, the **ATC controller can manage the MALE RPAS transit flight as just another IFR flight with neutral impacts on safety (SAF) and on human performance (HP)**.

No other Key Performance Areas are allocated to the solution, thus no specific Key Performance Indicators (KPI) are established. However, the solutions' cost benefit mechanism also provides **positive impacts (benefits)** on the following :

- **RPAS airspace user accessibility**
  - reduced planning lead-time to "file and fly"
  - regular routine RPAS GAT flight access to the whole IFR airspace

- **Equity is ensured to all airspace users, RPAS included**

The results reported are summarized from the validation results and expert workshops.

Table of Contents

List of Tables

List of Figures

1 Executive Summary

This document provides the Performance Assessment Report (PAR) for SESAR PJ13 (ERICA) Solution 115. The Performance Assessment Report (PAR) consolidates Solution 115 performance validation results addressing KPAs, KPIs/PIs and metrics from the SESAR2020 Performance Framework [3].

Solution Description:

SESAR PJ13 (ERICA) Solution 115 is a V3 solution in the existing European Air Traffic Management (ATM). It accommodates existing/initial Medium Altitude Long Endurance Remotely Piloted Aircraft System (MALE RPAS) flying under Instrument flight rules (IFR), as a general air traffic (GAT) non-segregated amongst other manned controlled traffic in controlled airspace classes A to C.

Solution 115 improves the situation of MALE RPAS transit flight operations, which previously required lengthy preparation and required segregation mechanisms and operations for flight. The improvement, through the RPAS Accommodation concept, is that the RPAS user can now rapidly file a GAT IFR flight plan and access airspace for transit flights in shared civil controlled airspace, amongst all other traffic.

Assessment Results Summary:

The following tables summarises the assessment outcomes per KPI (Table 1) and mandatory PI (Table 2) puts them side-by side against Validation Targets in case of KPI from PJ19 [7]. The impact of a Solution on the performances are described in Benefit Impact Mechanism.

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI)[1]	Confidence in Results[2]
SAF1: Safety - Total number of estimated accidents with ATM Contribution per year	**Safety Neutral**	**Safety Neutral**	**High**
FEFF1: Fuel Efficiency - Actual average fuel burn per flight	NA		
CAP1: TMA Airspace Capacity - TMA throughput, in challenging airspace, per unit time.	NA		
CAP2: En-Route Airspace Capacity - En-route throughput, in challenging airspace, per unit time	NA		
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	NA		
TEFF1: Gate-to-gate flight time	NA		
PRD1: Predictability – Average of Difference in actual & Flight Plan or RBT durations	NA		
PUN1: Punctuality – Average departure delay per flight	NA		
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty	NA		
CEF3: Technology Cost – Cost per flight	NA		

Table 1: KPI Assessment Results Summary

1 Negative impacts are indicated in red.

2 High – the results might change by +/-10%
Medium – the results might change by +/-25%
Low – the results might change by +/-50% or greater
N/A – not applicable, i.e., the KPI cannot be influenced by the Solution

Mandatory PI	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)[3]	Confidence in Results[4]
SAF1.X: Mid-air collision - En-Route	**Safety Neutral - Closed**	
SAF2.X: Mid-air collision - TMA	NA	
SAF3.X: RWY-collision accident	NA	
SAF4.X: TWY-collision accident	NA	
SAF5.X: CFIT accident	NA	
SAF6.X: Wake related accident	NA	
SAF7.X: RWY-excursion accident	NA	
SAF8.X ...: Other SAF Risks	NA	
SEC1: A security risk assessment has been carried out	NA	
SEC2: Risk Treatment has been carried out	NA	
SEC3: Residual risk after treatment meets security objective.	NA	
ENV1: Actual Average CO2 Emission per flight	NA	
NOI1: Relative noise scale	NA	
NOI2: Size and location of noise contours	NA	
NOI4: Number of people exposed to noise levels exceeding a given threshold	NA	
LAQ1: Geographic distribution of pollutant concentrations	NA	
CAP3.1: Peak Departure throughput per hour (Segregated mode)	NA	
CAP3.2: Peak Arrival throughput per hour (segregated mode)	NA	
CAP4: Un-accommodated traffic reduction	NA	

3 Negative impacts are indicated in red.

4 High – the results might change by +/-10%
Medium – the results might change by +/-25%
Low – the results might change by +/-50% or greater
N/A – not applicable, i.e., the KPI cannot be influenced by the Solution

RES1: Loss of Airport Capacity Avoided	NA	
RES1.1: Airport time to recover from non-nominal to nominal condition	NA	
RES2: Loss of Airspace Capacity Avoided.	NA	
RES2.1: Airspace time to recover from non-nominal to nominal condition.	NA	
RES4: Minutes of delays.	NA	
RES5: Number of cancellations.	NA	
TEFF2: Taxi in time	NA	
TEFF3: Taxi out time	NA	
TEFF4: TMA arrival time	NA	
TEFF5: TMA departure time	NA	
TEFF6: En-Route time	NA	
PRD2: Variance of Difference in actual & Flight Plan or RBT durations	NA	
PUN2: % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	NA	
CEF1: Direct ANS Gate-to-gate cost per flight	NA	
AUC3: Direct operating costs for an airspace user	NA	
AUC4: Indirect operating costs for an airspace user	NA	
AUC5: Overhead costs for an airspace user	NA	
CMC1.1: Allocated vs. Requested ARES duration	NA	
CMC1.2: Allocated vs. Requested ARES dimension	NA	
CMC1.3: Deviation of Transit Time to/from airbase to ARES	NA	
CMC 1.3.1: Allocated ARES duration vs. total mission duration	NA	
CMC 1.3.2: Deviation of total mission duration by iOAT FPL validation	NA	
CMC 1.4.1: Rate of iOAT FPLs acceptance by NM systems	NA	
CMC 1.4.2: Rate of iOAT FPLs acceptance by ATC systems	NA	

CMC2.1: Fuel and Distance saved by GAT	NA	
HP1: Consistency of human role with respect to human capabilities and limitations	**Closed, except Emergency (Partial)**	**High**
HP2: Suitability of technical system in supporting the tasks of human actors	**Closed**	**High**
HP3: Adequacy of team structure and team communication in supporting the human actors	**Closed**	**High**
HP4: Feasibility with regard to HP-related transition factors	**Closed**	**High**
FLX1: Average delay for scheduled civil/military flights with change request and non-scheduled or late flight plan request	NA	

Table 2 Mandatory PIs Assessment Summary

2 Introduction

The opinions expressed herein reflect the author's view only. Under no circumstances shall the SESAR3 Joint Undertaking be responsible for any use that may be made of the information contained herein.

2.1 Purpose of the document

The Performance Assessment covers the Key Performance Areas (KPAs) defined in the SESAR2020 Performance Framework [3]. Assessed are at least the Key Performance Indicators (KPIs) and the mandatory Performance Indicators (PIs), but also additional PIs as needed to capture the performance impacts of the Solution. It considers the guidance document on KPIs/PIs [3] for practical considerations, for example on metrics.

The purpose of this document is to present the performance assessment results from the validation exercises at SESAR Solution level. The KPA performance results are used for the performance assessment at strategy level and provide inputs to the SESAR3 Joint Undertaking (S3JU) for decisions on the SESAR2020 Programme.

In addition to the results, this document presents the assumptions and mechanisms (how the validation exercises results have been consolidated) used to achieve this performance assessment result.

One Performance Assessment Report shall be produced or iterated per Solution.

2.2 Intended readership

In general, this document provides the ATM stakeholders (e.g. airspace users, ANSPs, airports, airspace industry) and S3JU performance data for the Solution addressed.

Produced by the Solution project, the main recipient in the SESAR performance management process is PJ19, which will aggregate all the performance assessment results from the SESAR2020 solution projects PJ1-18, and provide the data to PJ20 for considering the performance data for the European ATM Master Plan. The aggregation will be done at higher levels suitable for use at Master Planning Level, such as deployment scenarios.

2.3 Inputs from other projects

The document includes information from the following SESAR 2020 Wave1 projects:

- PAGAR 2019: Performance Assessment and Gap Analysis Report (2019), where are collected the final benefits from SESAR 2020 Wave1.

PJ19 will manage and provide:

- SESAR Performance Framework (2019) [3], guidance on KPIs and Data collection supports.
- S2020 Common Assumptions, used to aggregate results obtained during validation exercises (and captured into validation reports) into KPIs at the ECAC level, which will in turn be captured in Performance Assessment Reports and used as inputs to the CBAs produced by

the Solution projects. Where are also included performance aggregation assumptions, with traffic data items.

- For guidance and support PJ19 have put in place the Community of Practice (CoP)[5] within STELLAR, gathering experts and providing best practices.

2.4 Glossary of terms

See the AIRM Glossary [5] for a comprehensive glossary of terms.

The following is a list of the concepts, terms or definitions introduced or commonly referred to in this document.

Term	Definition	Source
Airport Capacity Focus Area	Capture the peak runway throughput in the most challenging (or constrained) environments at busy hours, i.e. the capacity at a "maximum observed throughput" airport.	PAGAR
Airspace Capacity Focus Area	Capture the capability of a challenging volume of airspace to handle an increasing number of movements per unit time – through changes to the operational concept and technology.	PAGAR
Airspace Reservation/ Restriction (ARES)	Airspace Reservation means a defined volume of airspace temporarily reserved for exclusive or specific use by categories of users (Temporary Segregated Area (TSA), Temporary Reserved Area (TRA), and Cross-Border Area (CBA)) wheras Airspace Restriction designates Danger, Restricted and Prohibited Areas.	EC Regulation No 2150/2005
Airspace User Cost-Efficiency Focus Area	Cost-Efficiency obtained by Airspace Users other than direct gate-to-gate ATS costs (CEF1) or AU cost improvements assessed through other KPIs: Fuel Efficiency, Punctuality, etc. Note: Benefits assessed through other KPIs should not be included in this focus area to avoid double counting of benefits. AU Cost-Efficiency includes reduction of direct (AUC3) and indirect (AUC4) operational costs of the AU, as well as overhead costs (AUC5). In addition there are two specific PIs, Strategic Delay (AUC1) and Sequence Optimisation Benefit (AUC2).	PAGAR
ARES Capacity	The ability of an ATM system to accommodate specific training events which require airspace reservations and/or restrictions during a specific period of time, taking into account the duration of the training events, ATM inefficiency, planning inefficiency and weather impact on training and operations.	Performance Framework 2017

5 Go to "Advanced Portfolio Manager" on the left navigation menu, and select "Coordination Group – ATM Performance Assessment (APA)" in STELLAR

Term	Definition	Source
ATM Master Plan	The European ATM Master Plan is the agreed roadmap to bring ATM R&I to the deployment phase, introducing the agreed vision for the future European ATM system. It provides the main direction and principles for SESAR R&I, as well as the deployment planning and an implementation view with agreed deployment objectives. Through the SESAR Key Features, the ATM Master Plan identifies the Essential Operational Changes (both Essential Operational Changes featured in the Pilot Common Project and New Essential Operational Changes) and key R&I activities that support the identified performance ambition. The ATM Master Plan is updated on a regular basis in collaboration and consultation with the entire ATM community. Amendments are submitted to the S3JU Administrative Board for adoption. The content of the European ATM Master Plan is structured in three levels (Level 1 – Executive View, Level 2 – Planning and Architecture View, and Level 3 – Implementation View) to allow stakeholders to access the information at the level of detail that is most relevant to their area of interest. The intended readership for Level 1 is executive-level stakeholders. Levels 2 and 3 of the ATM Master Plan provide more detail on the operational changes and related elements and therefore the target audience is expert-level stakeholders.	SESAR2020 Project Handbook, European ATM Master Plan (9 Edition)
Civil-military coordination and cooperation	The coordination between the civil and military parties authorised to make decisions and agree a course of action.	Performance Framework 2017
Cost-Benefit Analysis	A Cost-Benefit Analysis is a process for quantifying in economic terms the costs and benefits of a project or a programme over a certain period, and those of its alternatives (within the same period), in order to have a single scale of comparison for unbiased evaluation. This process helps decision-makers to compare an investment with other possible investments and/or to make a choice between different options / scenarios and to select the one that offers the best value for money while considering all the key criteria affecting the decision.	PAGAR
Deployment Scenario	Set of SESAR Solutions selected to satisfy the specific Performance Needs of operating environments in the European ATM System and based on the timescales in which their performance contribution is needed in the respective operating environments.	PAGAR
Flexibility KPA	The ability of the ATM System and airports to respond to changes in planned flights and missions. It covers late trajectory modification requests as well as ATFCM measures and departure slot swapping and it is applicable to military and civil airspace users covering both scheduled and unscheduled flights. In terms of specific military requirements, it also covers the ability of the ATM System to address military requirements related to the use of airspace and reaction to short-notice changes.	Performance Framework 2017

Term	Definition	Source
Focus Area	Within each KPA, a number of more specific "Focus Areas" are identified in which there are potential intentions to establish performance management. Focus Areas are typically needed where performance issues have been identified.	ICAO Doc 9883
Fuel Efficiency Focus Area	The SESAR performance Focus Area concerned with fuel efficiency. How much fuel is used by aviation or by extension "Fuel efficiency" (how much fuel can be saved?) is one of the performance aspects. Note: Policy places considerable focus on this. Fuel efficiency contributes to 3 of the 11 KPAs defined by ICAO: Cost-efficiency, Efficiency, and Environment.	PAGAR
Gap Analysis	Difference between the validation targets and the performance assessment. It is used to: 1. Anticipate any deviation from the design performance targets; 2. Identify the underlying reasons; 3. Derive the appropriate recommendations to be taken on board to redirect the R&D activities within the Programme towards the ultimate achievement of SESAR2020's performance ambitions.	PAGAR
G2G ANS Cost-Efficiency Focus Area	One of the SESAR performance Focus Areas concerned with Cost Efficiency. Direct G2G ANS costs are those costs that are charged to Airspace Users via unit rates, including ATM/CNS costs, regulatory costs, Met costs and EUROCONTROL Agency costs.	Performance Framework new
Human Performance (HP)	Human capabilities and limitations which have an impact on the safety, security and efficiency of aeronautical operations.	EUROCONTROL ATM Lexicon
Key Performance Area	A way of categorising performance subjects related to high level ambitions and expectations. ICAO Global ATM Concept sets out these expectations in general terms for each of the 11 ICAO defined KPAs.	EUROCONTROL ATM Lexicon

Term	Definition	Source
Key Performance Indicator	Current/past performance, expected future performance (estimated as part of forecasting and performance modelling), as well as actual progress in achieving performance objectives is quantitatively expressed by means of indicators (sometimes called Key Performance Indicators, or KPIs). To be relevant, indicators need to correctly express the intention of the associated performance objective. Since indicators support objectives, they should not be defined without having a specific performance objective in mind. Indicators are not often directly measured. They are calculated from supporting metrics according to clearly defined formulas, e.g. cost-per-flight-indicator = Sum (cost)/Sum (flights). Performance measurement is therefore carried out through the collection of data for the supporting metrics." In SESAR2020 Performance Framework, Key Performance Indicators are those that have a validation target associated derived from the corresponding Performance Ambition.	ICAO Doc 9883 Performance Framework
Local Air Quality Focus Area	One of the SESAR performance Focus Areas concerned with Environment. Local air quality is a term commonly used to designate the state of the ambient air to which humans and the ecosystem are typically exposed at a specific location. In the case of aviation, local air quality studies are generally conducted near airports.	PAGAR
Noise Focus Area	One of the SESAR performance Focus Areas concerned with Environment. The term Noise is used in this document to designate noise pollution, which is defined as unwanted sound. The impact of unwanted sounds on the recipients (in this case, people living around airports) causes adverse effects.	PAGAR
Operational Environment (OE)	An environment with a consistent type of flight operations.	EUROCONTROL ATM Lexicon
Performance Ambitions	Performance capability that may be achieved if SESAR Solutions are made available through R&D activities, deployed in a timely and, when needed, synchronised way and used to their full potential.	EUROCONTROL ATM Lexicon
Performance assessment	This term relates to the quantitative estimate of the potential performance benefit of an operational improvement based on outputs from validation projects, collected and analysed by PJ19.04.02	ICAO Doc 9883 updated in PAGAR

Term	Definition	Source
Performance Framework	1) The overall performance-driven development approach that is applied within the SESAR development programme to ensure that the programme develops the operational concept and technology needed to meet long-term performance expectations. 2) The set of definitions and terminology describing the building blocks used by a group of ATM community members to collaborate on performance management activities. This set of definitions includes the levels in the global ATM performance hierarchy, the eleven , a set of process capability areas, focus areas, performance objectives, indicators, targets, , lists of dimension objects, their aggregation hierarchies and .	EUROCONTROL ATM Lexicon
Performance Indicator	PIs are defined in the SESAR performance framework and relate to performance benefits in specific KPAs. However, no validation targets are assigned to PIs. SESAR Solutions projects use the results of validation exercises to report performance assessment in terms of the PIs, reporting the expected positive and negative impacts. Certain PIs are mandatory for measurement and reporting by Solution projects.	SESAR2020 Project Handbook
Performance metrics	Sometimes proxies may be used in a validation exercise when it is not possible to measure an impact directly using the specified KPIs and PIs. In these cases, other metrics may be used provided the solution project later converts the results into the reporting KPIs and PIs.	SESAR2020 Project Handbook
Predictability Focus Area	Predictability is focused on in-flight (i.e. off-block to on-block) variability of flight duration compared to the planned duration. It is expected that this area will be extended in the future to reflect the improvement derived from better planning in pre-tactical phase.	Performance Framework 2019
Punctuality Focus Area	Refers to “ATM Punctuality”. It captures ATM issues as well as events related to ATM that cause a temporal perturbation to airspace user schedules.	PAGAR
Resilience Focus Area	Resilience focuses on the ability to withstand and recover from planned and unplanned events and conditions which cause a loss of nominal performance.	Performance Framework updated
Safety	The state to which the possibility of harm to persons or damage to property is reduced, and maintained at or below, an acceptable level through a continuing process of hazard identification and .	EUROCONTROL ATM Lexicon

Term	Definition	Source
Security	(aviation) Safeguarding civil aviation against . This objective is achieved by a combination of measures and human and material resources. Note: ATM Security is concerned with those threats that are aimed at the ATM System directly, such as attacks on ATM assets, or where ATM plays a key role in the prevention of or response to threats aimed at other parts of the aviation system (or national and international assets of high value). ATM security aims to limit the effects of a threats on the overall ATM Network. ATM Security is a subset of Aviation Security (as defined by ICAO in Annex 17).	EUROCONTROL ATM Lexicon, Note are from PAGAR
SESAR2020	The Programme for SESAR2020 was created with a clear and agreed need for continuing research and innovation in ATM beyond the SESAR 1 development phase. SESAR2020 is structured into three main research phases, starting with Exploratory Research, which is then further expanded within a Public-Private-Partnership (PPP) to conduct Industrial Research and Validation. Finally, it further exploits the benefits of the PPP in Demonstrating at Large Scale the concepts and technologies in representative environments to firmly establish the performance benefits and risks.	Performance Framework 2017
SESAR Programme	The programme which defines the Research and Development activities and Projects for the S3JU.	EUROCONTROL ATM Lexicon
SESAR Solution	A term used when referring to both SESAR ATM Solution and SESAR Technological Solution.	SESAR2020 Project Handbook
SESAR ATM Solution	SESAR Solutions relate to either an Operational Improvement (OI) step or a group of OI steps with associated Enablers (technical system, procedure or human), which have been designed, developed and validated in response to specific Validation Targets and that are expected deliver operational and/or performance improvements to European ATM, when translated into their effective realisation. SESAR Technological Solutions relate to verified technologies proven to be feasible and profitable, which may therefore be considered to enable future SESAR Solutions.	SESAR2020 Project Handbook
Single European Sky High Level Goals	The SES High Level Goals are political targets set by the European Commission. Their scope is the full ATM performance outcome resulting from the combined implementation of the SES pillars and instruments, as well as industry developments not driven directly by the EU.	SESAR2020 Project Handbook
Sub-OE	A subcategory of an Operating environment, classified according to its complexity (e.g. high complexity TMA, medium complexity TMA, low complexity TMA).	EUROCONTROL ATM Lexicon
Validation targets	Validation targets are the targets that focus on the development of enhanced capabilities by the SESAR Solutions. They aim to secure from R&D the required performance capability to contribute to the achievement of the Performance Ambitions and, thus, to the SES high-level goals. In SESAR2020 validation targets are associated with a KPI.	EUROCONTROL ATM Lexicon

Table 3: Glossary

2.5 Acronyms and Terminology

Acronym	Definition
A/C	Aircraft
AFCS	Auto Flight Control System
ACC	Area Control Centre
A/G	Air/Ground
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Services
ANS	Air Navigation Service
ANSP	Air Navigation Service Provider
AO	Aircraft Operator
AOC	Airline Operation Centre
AOCC	Airline Operations and Control Centre
AOP	Airport Operations Plan
AoR	Air of Responsibility
APP	Approach
ARES	Airspace Reservation/Restriction
ARS	Air control center, RPA production center, Sensor fusion post
ASAP	As Soon As Possible
ASM	Airspace Management
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
ATMS	Air Traffic Management System
ATS	Air Traffic Service
ATSU	Air Traffic Service Unit
AU	Airspace User

Acronym	Definition
BAD	Benefits Assessment Date
BADA	Base of Aircraft Data
BAER	Benefit Assessment Equipment Rate
BIM	Benefit Impact Mechanism
BMT	Business Mission Trajectory
BRLOS	Beyond Radio Line Of Sight
BVLOS	Beyond Visual Line of Sight
C2	Command and Control
C2LL	C2 Link Loss
C3	Command, Control and Communication
CASA	Civil Aviation Safety authority
CBA	Cost Benefit Analysis
CESNAC	“Systèmes de Navigation Aérienne Centraux”
CDM	Collaborative Decision-Making
CFMU	Central Flow Management Unit
CNS	Communication Navigation and Surveillance
COM	Communication
CONOPS	Concept of Operations
CR	Change Request
CRNA	“Centre en Route de la Navigation Aérienne”
CTA	Control Area
CTR	Control Area
CWP	Controller Working Position
DA	Decision Altitude
DAA	Detect And Avoid
DAP	Data Operation Provider
DB	Deployment Baseline
DCB	Demand Capacity Balancing
DOD	Detailed Operational Description
EASA	European Airspace Safety Agency
EATMA	European ATM Architecture

Acronym	Definition
E-ATMS	European Air Traffic Management System
EC	European Commission
ECAC	European Civil Aviation Conference
ERA	Enhanced RPAS Automation
EREA	European Research Establishments in Aeronautics
ERICA	Enable RPAS Insertion in Controlled Airspace
ERSG	European RPAS Steering Group
ETA	Estimated Time of Arrival
ETD	Estimate Timed of Departure
EUROCAE	European Organisation for Civil Aviation Equipment
EUMC	European Union Military Committee
EU	European Union
EUR	Europe
FAA	Federal Aviation Administration
FF-ICE	Flight & Flow Information for a Collaborative Environment
FIS-B	Flight Information Services - Broadcast
FIR	Flight Information Region
FL	Flight Level
FOC	Flight Operation Centre
FPL or FPLN	Flight Plan
Ft (ft)	Feet
FTA	Flight Termination Area
FUA	Flexible Use of Airspace
GA	General Aviation
GAT	General Air Traffic
G/G	Ground/Ground
GND	Ground
GPS	Global Positioning System
GS	Ground Station
HALE	High Altitude Long Endurance
HL	High Level

Acronym	Definition
HLR	High Level Requirement(s)
HP	Human Performance
HPAR	Human Performance Assessment Report
HV	Horizontal Vertical
ICAO	International civil Aviation Organisation
IFACTCA	International Federation of Air Traffic Controllers
IFALPA	International Federation of Air Line Pilots' Associations
IFPS	Integrated Initial Flight Plan Processing System
IFPSZ	Integrated Initial Flight Plan Processing System Zone
IFR	Instrumental Flight Rules
ILS	Instrumental Landing System
INS	Inertial Navigation System
INTEROP	Interoperability Requirements
iOAT (FPL)	improved Operational Air Traffic (Flight Plan)
IOP	Input Output Processor
IRS	Interface Requirements Specification
JAA	Joint Aviation Authorities
JARUS	Joint Authorities for Rulemaking on Unmanned Systems
JFAC	Joint Force Air Component Commander
LALE	Low-Altitude Long-Endurance
Lat	Latitude
LoA	Letters of Agreement
Long	Longitude
KPA	Key Performance Area
KPI	Key Performance Indicator
MAC	Mid-Air Collision
MALE	Medium Altitude Long Endurance
MASPS	Minimum Aviation System Performance Standards
MIL	Military
MSA	Minimum Sector Altitude
MSOC	Mission Operations Support Centre

Acronym	Definition
MTCD	Mid-Term Conflict Detection
N/A or **NA**	Not Applicable
NAA	National Aviation Authority
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NAV	Navigation
NB	Nota-Bene
NM	Nautical Mile or Network Manager
NMF	Network Management Function
NMOC	Network Manager Operations Centre
NOP	Network Operation Plan
NOTAM	Notice To Airmen
OAT	Operational Air Traffic
OC	Operation Centre
OE	Operating Environment
OI	Operational Improvement
OPAR	Operational Performance Assessment Report
OPs	Operations
OSED	Operational Service and Environment Definition
PAR	Performance Assessment Report
PBN	Performance Based Navigation
PCA	Prior Coordination Airspace
PI	Performance Indicator
PIC	Pilot In Command
PRU	Performance Review Unit
QoS	Quality of Service
RBT	Reference Business Trajectory
RBMT	Reference Mission/Business Trajectory
RBT	Reference Business Trajectory
R/C	Radio Control
ReqMT	Required Mission Trajectory

Acronym	Definition
R&D	Research & Development
RLOS	Radio Line of Sight
RMT	Reference Mission Trajectory
RMM	Risks Mitigation Means
RNP	Required Navigation Performance
RNP AR	RNP Authorized
RP	Remote Pilot
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft Systems
RPASP	Remotely Piloted Aircraft Systems Panel
RPS	Remote Pilot Station
R/T	Receiver/Transceiver or Radiotelephony (EASA)
RVSM	Reduced Vertical Separation Minima
RWC	Remain Well Clear
SAC	Safety Criteria
SAR	Safety Assessment Report
SARPS	Standards And Recommended Practices
SBMT	Shared Business Mission Trajectory
SBT	Shared Business Trajectory
SCTA	Short Term Conflict Alert
SMT	Shared Mission Trajectory
SDM	Service Delivery Management
SecAR	Security Assessment Report
SERA	Standardised European Rules of the Air
SES	Single European Sky
SESAR	Single European Sky ATM Research Programme
SESAR2020 Programme	The programme which defines the Research and Development activities and Projects for the S3JU
SID	Standard Instrument Departure
SJU or S3JU	SESAR 3 Joint Undertaking (Agency of the European Commission)
SoS	System of System
SPO	Single Person Operations

Acronym	Definition
SPR	Safety and Performance Requirements
SSR	Secondary Surveillance Radar
STAR	Standard Terminal Arrival
STCA	Short-Term Conflict Alert
SURV	Surveillance
SWaP	Size, Weight and Power
TAA	Terminal Area Altitude
TBC	To Be Confirmed
TBD	To Be Defined
TCAS	Traffic Alert and Collision Avoidance System
TIS-B	Traffic Information Services - Broadcast
TMA	Terminal Area
ToC	Top of Climb
ToD	Top of Descent
TRA	Temporary Reserved Area
TS	Technical Specification
TSA	Temporary Segregated Area
TWR	Tower
UAS	Unmanned Aircraft system
UAV	Unmanned Aerial Vehicle
UC	Use Case
UDPP	User Driven Prioritisation Process
UHF	Ultra High Frequency
ULTRA	Unmanned Aerial Systems in European Airspace
USAF	United States Air Forces
UTM	Unmanned (Aircraft Systems) Traffic Management
VALP	Validation Plan
VALR	Validation Report
VFR	Visual flight Rules
VHF	Very High Frequency
VLL	Very Low Level

Acronym	Definition
VLOS	Visual Line Of Sight
VMC	Visual Meteorological Conditions
VNAV	Vertical Navigation
VOR/DME	VHF Omnidirectional Range/Distance measurement Equipment
V&V	Validation and Verification
WG	Working Group
WOC	Wing Operation Centre
WP	Work Package
WPT	Waypoint
WRC	World Radio communication Conference
XPDR	Transponder
ZIT	Zones Interdites (French) / Prohibited zones
ZRT	Zones Règlementées (French) / Restricted zones

Table 4: Acronyms and terminology

3 Solution Scope

3.1 Detailed Description of the Solution

SESAR PJ13 (ERICA) Solution 115 is a V3 solution in the short-medium term within the existing European Air Traffic Management (ATM) which accommodates existing/initial Medium Altitude Long Endurance Remotely Piloted Aircraft System (MALE RPAS) in controlled airspace.

Solution 115 improves the situation of MALE RPAS transit flight operations, which previously required lengthy preparation and required segregation mechanisms and operations for flight. The improvement, through the RPAS Accommodation concept, is that the RPAS user can now rapidly access and fly a transit flight in shared airspace, amongst all other traffic, in airspaces classified Low/ Medium complexity and derived also to High complexity airspace during low traffic periods

In more detail, Solution S115's concept covers:

- Flight preparation/planned flight changes. This process becomes as short as for a manned aircraft IFR (Instrument Flight Rules) flight. The RPAS flight can be routinely planned with no segregation/reserved airspace for its IFR transit flight as GAT.

- MALE RPAS management by civil Air Traffic Control (ATC) where the RPAS benefits from the available shared controlled airspace. In this airspace low numbers of RPAS (a single RPAS per control sector) fly under Instrument flight rules (IFR), as a general air traffic (GAT). The RPAS is non-segregated amongst other manned controlled traffic in controlled airspace classes A to C. No priorities are applied, resulting in equitable traffic management of all airspace users as well as the RPAS in the controlled airspace. A derived benefit to other airspace users of the controlled airspace is that their flights can be more efficient as the airspace reservations are no longer required for the RPAS transit flight.

The concept requires no or a minor technical change to the ATM systems and procedures already exist and are in operation. The RPAS are have already been acquired by the operators and the solution is defined for such RPAS to be used at no additional cost in their existing configuration.

3.2 Detailed Description of relationship with other Solutions

Solution Number	Solution Title	Relationship	Rational for the relationship
Sol. 117	IFR RPAS integration in Airspace Class A to C	Compatible, Independent, No cross effect	Although both solutions PJ.13-W2-115 and PJ.13-W2-117 address RPAS flight is controlled airspace, their timeframe and solution scope are independent. PJ.13-W2-115 may be seen as a precursor in time to PJ.13-W2-117. However PJ.13-W2-115 addresses procedural accommodation based on existing ATM systems and initial existing RPAS, whereas PJ.13-W2-117 independently addresses integration based on evolved ATM and RPAS systems/technologies and procedures.

Table 5: Relationships with other Solutions

4 Solution Performance Assessment

4.1 Assessment Sources and Summary of Validation Exercise Performance Results

No previous validation Exercises (pre-SESAR2020 Wave 2, etc.) are relevant for this assessment.

No preceding project on RPAS accommodation exists. Preceding Wave 1 PJ 10.05 did not perform RPAS accommodation validation, and no previous performance can be derived from this source.

SESAR Validation Exercises of this Solution (completed ones and planned ones) are listed below.

Exercise ID	Exercise Title	Release	Maturity	Status
EXE_115_001	RTS INTEGRATED V3 VALIDATION	R12	V3	Complete

Table 6: SESAR2020 Validation Exercises

The following table provides a summary of information collected from available performance outcomes.

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
EXE_115_001	AUO-0619	Operationally significant RTS with qualified ATCOs & RPAS Remote Pilot : IFR management of RPAS transit in controlled airspace with C2 link loss procedure	Safety Human Performance Equity	

Table 7: Summary of Validation Results.

4.2 Conditions / Assumptions for Applicability

The following Table 8 summarises the applicable operating environments.

OE	Applicable sub-OE	Special characteristics
En-Route - ER	Medium Complexity Low Complexity	One RPAS per control sector is operating under IFR as GAT. Traffic conditions are low to mid density. High & Very-High complexity sub-OEs are possible operating environments, only during low traffic periods.
		•Class A-C controlled airspace, all traffic under ATC cooperative surveillance •Transit operations as GAT (Climb/Descent/Cruise between ~FL100 to FL200) •Accommodation is performed through operational procedures, using the existing mechanisms and systems already in place, also considering RPAS are not fully compliant with ICAO standards •Low RPAS numbers (estimated 1 RPAS per controlling sector)

Table 8: Applicable Operating Environments.

Additional notes:

TMA associated Departure/Arrival/Terminal manoeuvring patterns (i.e. merging sequencing, SID/STAR /APP) are outside the solution scope. This portion of flight remains as currently performed under OAT from/to dedicated airfields.

Mission flight zones & patterns also remain as currently performed in dedicated mission area, outside the solution scope (outside the IFR GAT transit segment).

4.3 Safety

The different hazards inherent to aviation, and those system-generated hazards prior to Change introduction have been preliminary identified, and the related Safety Criteria have been stated. It is important to highlight that the main concern regarding the accommodation of RPAS in controlled airspace are mid-air collisions and, therefore, the hazards and SACs are mainly focused on these events, and their precursors and barriers.

One further step will be the identification of the different activities related to safety that will need to be conducted within the Solution, the so-called Safety Assurance Activities, with which the Team has forecasted to deal in the next weeks.

Safety outcomes mainly come from the safety assessment per the SESAR Safety Reference Material (SRM), resulting in the Safety Assessment Report (SAR, ref []), and which has also been fed by expert experience from ongoing RPAS accommodation trials flight experience and from Real Time Simulation validation performed in March 2022 in Clermont-Ferrand with operational ATCOs and a qualified RPAS remote pilot; in this RTS, no Near Mid-Air Collision was observed.

The SAR analysed RPAS accommodation from a safety perspective, considering both an RPAS flying in nominal and non-nominal situations within the target operational environment, identifying and evaluating the risks that it generates, and selecting mitigation measures to minimize or eliminate the impact of these risk on the current aviation system. The SAR established a series of Safety Requirements, both at ATS service level (SRS) and at refined design level (rSRD).

4.3.1 Safety Design drivers and Performance Mechanism

The safety validation objectives presented in this Solution 115 were formulated as safety criteria (SACs) measurable at precursor level in the Accident Incident Model (AIM). The AIM used and relevant to the solution is Mid Air Collision, EN-Route (MAC-ER). No other AIM model is impacted by the solution.

The Safety Criteria (SAC) for this ATS operational Solution established are:

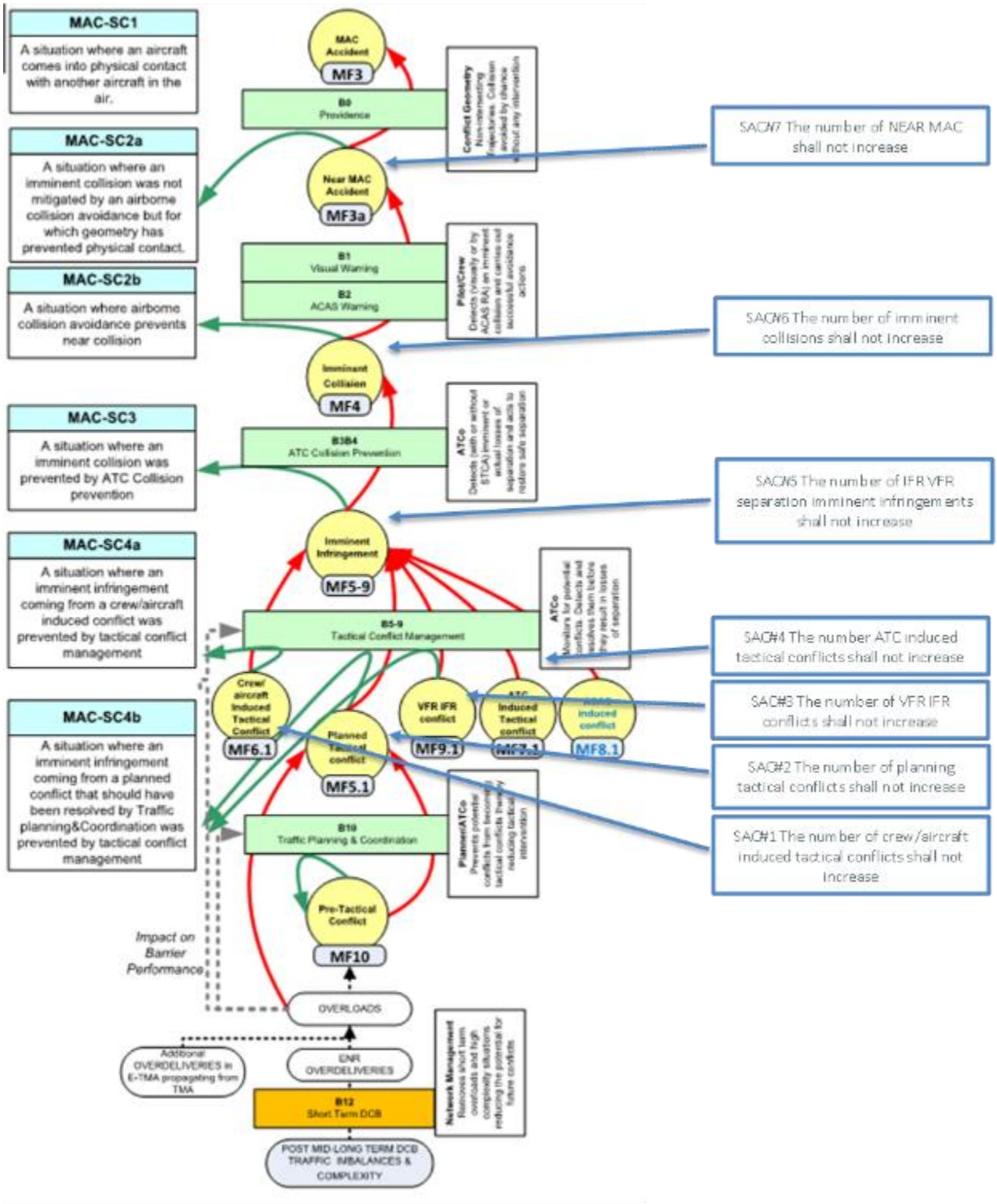

Figure 1: Severity Class Scheme for Mid-air Collision ENR with Solution 115 SAC

4.3.2 Data collection and Assessment

Two sources of assessments can be considered for the collection of evidences to the overall safety assessment:

- workshops & resulting safety assessment material documented in the S115 SAR (Ref [])

- RTS Validation, observations & feedback to questionnaires documented in the S115 validation report (VALR [9]).

The assessment first specified Safety Requirements at ATS Service level (SRS) which are the desired safety behaviour of the change at its interface with the ATS operational context considering normal and abnormal conditions of the context (success approach) and the failures of the functional system (failure approach). They are placed on the services of the Solution functional system that are changed or affected by the change (through change in behaviour or through new interactions introduced).

The SRDs establish the design characteristics/items of the solution functional system to ensure that the system operates as specified and is able to achieve the SACs.

A final consolidated list of Safety Requirements at Design level (functionality and performance) associated to internal system failures was established.

Full details are available in the SAR [14].

Safety Requirement ID	Safety Requirement at Design level (SRD) (functionality & performance)
SRD 001	RP shall be trained, and shall be able to apply new operating methods including the communication to ATCO of the two additional elements related to C2LL contingency procedure, and specific RPAS preparation procedures for RPAS nominal situations
SRD 002	RP shall provide C2 link loss pre-programmed contingency information for ATCO pre-awareness
SRD 003A	ATCO shall be able to easily recognise the RPAS traffic
SRD 003B	The RP shall add "REMOTE" to the callsign
SRD 004	ATC shall be able to support the accommodation of non-segregated transit GAT RPAS among all other GAT
SRD 005	ATCO shall be trained and shall be able to apply standard IFR procedures/operating methods to RPAS for nominal IFR situations thus to reiterate requests to RP for expected information
SRD 006	ATCO shall be able to perform surveillance of RPA with the current secondary surveillance tools and technologies which are compatible with airborne Mode A/C transponders (i.e. primarily secondary surveillance radar (SSR)) *NOTE: This includes that the ATC system shall process and highlight specific C2 link loss transponder code on CWP.*
SRD 007	ATCO shall be able to use usual controller tools based on RPAS performances
SRD 008	RP shall be able to modify the RPAS pre-programmed navigation according to the new instructions

Safety Requirement ID	Safety Requirement at Design level (SRD) (functionality & performance)
SRD 009	RP shall always pre-program RPA with a C2LL trajectory that shall be automatically triggered and flown when the RPAS goes into a C2LL state *NOTE: The RP shall re-program this C2LL trajectory whenever it is required*
SRD 010	Procedures regarding the transfer of control of RPAS between ATS units in nominal conditions shall be used per the LoA or operations manual in effect
SRD 011	ATC shall be able to use the usual tools as used for manned aircraft to detect possible conflicts: • Medium-Term Conflict Detection (MTCD) probe; • Short-Term Conflict Alert (STCA) safety net)
SRD 012	RPA shall be able to automatically provide specific C2 link loss transponder code and to maintain it active during C2 link loss
SRD 013	The first one of ATCO/RP who observes the C2 link loss shall be able to contact the other using the backup telephone line
SRD 014	A direct telephone line shall be available between ATC and RP/RPS as backup solution in C2 link loss situation
SRD 015	ATCO shall be trained and shall be able to apply adapted procedures/ operating methods for RPAS non-nominal situations
SRD 016	Only one RPAS shall be authorized to fly at the same time under responsibility of one sector *(For specific cases where RPAS are operating in pairs, RPAS Operators shall guarantee that two RPAs under the responsibility of one sector and suffering a C2LL will not have crossing trajectories at any time during the contingency)*
SRD 017	ATC shall be able to support the specific RPAS contingency procedures: • Recognize C2LL information provided in the procedure to know possible C2LL trajectory of RPAS
SRD 018	RPAS shall be able to identify its emergency status and to execute the emergency procedure associated with the severe failure situation
SRD 019	RPAS shall be able to set specific emergency transponder code and to maintain it active during emergency
SRD 020	ATC shall be able to manage RPAS emergency situation
SRD 020	RPAS shall be able to identify its emergency status and to execute the emergency procedure associated with the severe failure situation with RP in the loop
SRD 021	RPAS shall be able to remain on the RP controlled/selected trajectory, which takes into account emergency performance
SRD 022	A team of pilots shall be always available to manage the RPA, and at all times during flight there will be one pilot designated Pilot in Command in the RP position
SRD 023	RP shall be able to execute the standard IFR contingency procedures and operating methods identically to manned aviation: • Voice Comm loss with No C2 link loss; • GNSS/positioning loss; • Transponder failure/loss..
SRD 024	RP shall be trained and shall be able to apply new procedures including specific RPAS preparation procedures and operating methods for RPAS non-nominal situations. RP will, if necessary, re-program diversion preparation in case of changes in nominal flight (i.e. prior to C2LL)

Safety Requirement ID	Safety Requirement at Design level (SRD) (functionality & performance)
SRD 025	RPAS shall be able to navigate during flight in a structured airspace with performances and capabilities associated with the airspace, including the C2LL trajectory: • Positioning aids (GNSS, inertial); • AIRAC cyclic navigation data (ATS routes, waypoints); • RNAV required in the class A-C airspace environment (RNAV5 En-Route / RNAV1 Terminal). *The aim is to ensure the capability of the system in nominal conditions and while applying C2LL procedures.*
SRD 026	RPS Operations shall be able to plan flight within flight levels where a minimum traffic risk is usually present *NOTE: The span of flight levels considered will usually be above low levels to minimise recreational VFR traffic risk (> FL100), and below high levels to minimise flying within high speed cruising jet aircraft (~ FL200). Nevertheless, these vertical limits could be adapted depending on the specific characteristics of each operational environment*
SRD 027	RPAS shall fly low speeds (below 200 knots) in order to allow ATCO sufficient time to update the RPA clearance or re-organize the traffic around RPAS after C2LL occurrence

Table 9. SRD (functionality & performance) to mitigate the operational hazards

4.3.3 Extrapolation to ECAC wide

Safety Assessment and resulting SAR material may be used by any European state that has a RPAS accommodation need in the short-mid term.

4.3.4 Discussion of Assessment Result

The validation exercise (RTS) allows to verify the compliance with the defined safety criteria for all safety validation objectives. This confirms the ATS Operational Solution 115 enables the management of an RPAS flight efficiently and safely, both in normal and abnormal conditions, and maintains the level of safety within the airspace. It is observed that the measures designed for the flight of RPAS are efficient and solve the particularities of these aircraft, such as the C2LL behaviour.

One important consideration that has emerged is that at the time of the first radio contact with every ATCO the RPA is transferred to, the former has to be informed that the aircraft is a RPAS and has to be provided with details of the pre-programmed RPAS C2LL trajectory.

There is one validation criterion that could not be covered by any validation means. This is the CRT-PJ13.115-V3-VALP-007-0004 “Safe recovery of RPAS degraded operations in airspace classes A, B, C during accommodation”, as the RTS does not reproduce the completion of a C2LL and reversion to nominal flight.

4.3.5 Additional Comments and Notes

NA

4.4 Environment: Fuel Efficiency / CO2 emissions

Does the Solution impact this KPA? No

The solution is designed for RPAS access in low numbers. It has extremely low and marginal impact on overall Fuel Efficiency / CO2 emissions.

4.4.1 Performance Mechanism

NA

4.4.2 Assessment Data (Exercises and Expectations)

NA**Extrapolation to ECAC wide**

NA

4.4.4 Discussion of Assessment Result

NA

4.4.5 Additional Comments and Notes

NA

4.5 Environment / Emissions, Noise and Local Air Quality

Does the Solution impact this KPA? No

The solution is designed for RPAS access in low numbers. It has no impact on overall Environment / Emissions, Noise and Local Air Quality.

4.5.1 Performance Mechanism

NA

4.5.2 Assessment Data (Exercises and Expectations)

NA

4.5.3 Extrapolation to ECAC wide

NA

4.5.4 Discussion of Assessment Result

NAAdditional Comments and Notes

NA.Airspace Capacity (Throughput / Airspace Volume & Time)

Does the Solution impact this KPA? No

The solution is designed for RPAS access in low numbers in a low-mid traffic density environment It has no impact on Airspace Capacity.

4.6.1 Performance Mechanism

NA

4.6.2 Assessment Data (Exercises and Expectations)

NA

4.6.3 Extrapolation to ECAC wide

NA

4.6.4 Discussion of Assessment Result

NAAdditional Comments and Notes

NA

4.7 Airport Capacity (Runway Throughput Flights/Hour)

Does the Solution impact this KPA? No

Airport (departure / arrival) is out of scope of the solution. The solution is designed for RPAS En-Route transit flights low-mid traffic density environment. It has no impact on Airspace Capacity.

4.7.1 Performance Mechanism

NAAssessment Data (Exercises and Expectations)

NA

4.7.3 Extrapolation to ECAC wide

NA

4.7.4 Discussion of Assessment Result

NAAdditional Comments and Notes

NA

4.8 Resilience (% Loss of Airport & Airspace Capacity Avoided)

Does the Solution impact this KPA? No

4.8.1 Performance Mechanism

NA**Assessment Data (Exercises and Expectations)**

NA

4.8.3 Extrapolation to ECAC wide

NA

4.8.4 Discussion of Assessment Result

NA

4.8.5 Additional Comments and Notes

NA

4.9 Flight Times

Does the Solution impact this KPA? No

4.9.1 Performance Mechanism

NA

Assessment Data (Exercises and Expectations)

NA

Extrapolation to ECAC wide

NA

4.9.4 Discussion of Assessment Result

NA

4.9.5 Additional Comments and Notes

NA

4.10Predictability

Does the Solution impact this KPA? No

4.10.1Performance Mechanism

NAAssessment Data (Exercises and Expectations)

NA

4.10.3Extrapolation to ECAC wide

NA

4.10.4Discussion of Assessment Result

NA

4.10.5Additional Comments and Notes

NA

4.11Punctuality

Does the Solution impact this KPA? No

4.11.1Performance Mechanism

NAAssessment Data (Exercises and Expectations)

NA

4.11.3Extrapolation to ECAC wide

NA

4.11.4Discussion of Assessment Result

NA

4.11.5Additional Comments and Notes

NA

4.12Civil-Military Cooperation and Coordination (Distance and Fuel)

Does the Solution impact this KPA? No

4.12.1Performance Mechanism

NAAssessment Data (Exercises and Expectations)

NAExtrapolation to ECAC wide

NA

4.12.4Discussion of Assessment Result

NA

4.12.5Additional Comments and Notes

NA

4.13Flexibility

Does the Solution impact this KPA? No

4.13.1Performance Mechanism

NAAssessment Data (Exercises and Expectations)

NA

4.13.3Extrapolation to ECAC wide

NA

4.13.4Discussion of Assessment Result

NAAdditional Comments and Notes

NA

4.14Cost Efficiency

Does the Solution impact this KPA? No

4.14.1Performance Mechanism

NAAssessment Data (Exercises and Expectations)

NA

4.14.3Extrapolation to ECAC wide

NA

4.14.4Discussion of Assessment Result

NA

4.14.5Additional Comments and Notes

NA

4.15Airspace User Cost Efficiency

Does the Solution impact this KPA? No

4.15.1Performance Mechanism

NA

4.15.2Assessment Data (Exercises and Expectations)

NA

4.15.3Extrapolation to ECAC wide

NA

4.15.4Discussion of Assessment Result

NA

4.15.5Additional Comments and Notes

NA

4.16Security

4.16.1The SecRAM 2.0 methodology and the Security Performance Mechanism

This Wave 2, PJ.13-W2-115 RPAS Accommodation has the specificity of relying on existing ATM mechanisms/systems already in place and used in everyday operational traffic management as well as existing initial demand MIL RPAS.

Security assessment and controls in this existing system are assumed acceptable and no changes are intended in the deployment of s115 accommodation procedures (no new security to be addressed).

4.16.2Security Assessment Data Collection

NA

4.16.3Extrapolation to ECAC wide

NADiscussion of Assessment Result

NA

4.16.5Additional Comments and Notes

NA

4.17Human Performance

4.17.1HP arguments, activities and metrics

The main HP focus considered operating methods are identical to managing manned IFR traffic in controlled class A-C airspace including RPAS as just another GAT under IFR ; In addition, due to the RPAS specificity, HP assessments included the addition of an adapted operating method for ATCO awareness: provision of what the pre-programmed C2 Link Loss RPA behaviour would be in case it occurs.

Hence, relevant Human Performance (HP) arguments selected to be assessed were the following, with associated (B)enefits / (I)ssues :

HP1 **Consistency of human role with respect to human capabilities and limitations**	**HP1.2 Adequacy of operating methods (procedures) in supporting human performance**
	121 Operating methods cover operations in normal operating conditions
	122 Operating methods cover operations in abnormal operating conditions
	123 Operating methods cover degraded modes of the ATM system
	124 The content of operating methods is clear and consistent
	125 Operating methods (procedures) can be followed in an accurate, efficient, and timely manner
	HP1.3 Capability of human actors to achieve their tasks in a timely manner, with limited error rate and acceptable workload level
	131 The potential for human error is reduced to a tolerable level
	132 Tasks can be achieved in a timely manner
	133 The level of workload (induced by cognitive and/or physical task demands) is acceptable
	134 The level of trust in the new concept/the new procedures is appropriate
	135 Human actors can maintain a sufficient level of situation awareness
	136 Human actors can maintain a sufficient level of situation awareness
HP2 **Suitability of technical system in supporting the tasks of human actors**	**HP2.2 Adequacy of technical systems in supporting Human Performance with respect to timeliness of system responses and accuracy of information provided**
	222 The timeliness of information provided by the system is adequate for carrying out the task
	HP2.3 Adequacy of the human machine interface in supporting the human in carrying out their tasks.
	231 The type of information provided satisfies the information requirements of the human

HP3 **Adequacy of team structure and team communication in supporting the human actors**	**HP3.3 Adequacy of team communication with regard to information type, technical enablers and impact on situation awareness/workload**
	332 The phraseology supports communication in all operating conditions
	334 The communication load of team members is acceptable in normal and abnormal conditions and degraded mode of operations
HP4 **Feasibility with regard to HP-related transition factors**	335 Team members can maintain a sufficient level of shared situation awareness.
	HP4.1 User acceptability of the proposed solution
	412 The impact of changes on the job satisfaction of affected human actors has been considered
	HP4.2 Feasibility in relation to changes in competence requirements
	421 Knowledge, skill and experience requirements for human actors have been identified

Table 9: HP arguments, activities and metrics

HP assessments and outcomes have been obtained through:

- Real Time Simulation (RTS) validation performed in March 2022 in Clermont-Ferrand with operational ATCOs and a qualified RPAS remote pilot. . Each RTS run also embedded a debriefing and a questionnaire to collect ATCO ‘s feedback.

- Experts’ judgement collected during dedicated workshop.

The overall summary is that ATCOs and analysis from the expert feedback conclude:

- The accommodation concept in controlled airspace class A to C, with a RPAS as just another IFR traffic is feasible.

- Neither ATCO workload nor safety are affected by the RPAS transit.

- No significant additional exchanges between the remote pilot and the ATCOs and duration of all messages were noted.

- Although the provision of the C2LL behaviour may be seen as an exception to this, feedback is that such information is not different to similar additional information exchanges with manned aircraft pilots. The concept’s procedure for provision of the C2LL behaviour was deemed acceptable and not too long.

Complete details are provided in the OSED Part IV (HP Assessment Report - HPAR) [17]

sesar JOINT UNDERTAKING

PIs	2nd level / HP Arg.	Activities	Metrics	Covered
HP1 Consistency of human role with respect to human capabilities and limitations	**HP1.1 Clarity and completeness of role and responsibilities of human actors**			N/A
	HP1.2 Adequacy of operating methods (procedures) in supporting human performance			
	121-001 (B)	RTS and Feedback	Observation, debriefing, questionnaire, Qualitative and quantitative(workload and safety)	Closed
	122-001 (I)	RTS and Feedback	Observation, debriefing, questionnaire, Qualitative, quantitative(workload and safety)	Closed
	122-002 (B)	RTS and Feedback	Observation, debriefing, questionnaire, Qualitative	Closed
	123-001 (B)	RTS, Feedback, Expert judgment	Observation, debriefing, questionnaire, Qualitative, quantitative(workload)	Closed
	124-001 (B)	RTS and Feedback	Observation, debriefing, questionnaire, Qualitative, quantitative(workload)	Closed
	124-002 (I)	RTS (with procedure) and Feedback	Observation, debriefing, questionnaire, Qualitative, quantitative(workload)	YES for C2LL Partial for Emergency
	125-001 (I)	RTS and Feedback (incl. Existing situation)	Observation, debriefing, questionnaire, Qualitative(workload)	Closed
	HP1.3 Capability of human actors to achieve their tasks in a timely manner, with limited error rate and acceptable workload level			
	131-001 (B)	RTS	Questionnaire, debriefing, quantitative(safety)	Closed
	131-002 (I)	RTS and Feedback	Observation, debriefing and questionnaire, Qualitative	Closed
	132-001 (I)	Feedback (incl. previous project & OPS expert)	Questionnaire, previous project feedbacks and operational expert feedback, quantitative(safety)	Closed
	132-002 (I)	RTS, Feedback (incl. previous project & OPS expert)	RTS, questionnaire, previous project feedback and operational expert feedback, qualitative	Closed
	133-001 (I)	RTS and Feedback	Questionnaire, debriefing and observation, Qualitative, quantitative(workload)	Closed
	134-001 (B)	Feedback	Questionnaire, Qualitative	Closed
	134-002 (I)	RTS and Feedback	Observation, debriefing and questionnaire, Qualitative	Closed
	135-001 (B)	RTS and Feedback	Observation, debriefing and questionnaire, Qualitative	Closed

Co-funded by

	136-100 (B)	RTS, Feedback	Debriefing and questionnaire, Qualitative	Closed
	136-101 (B)	RTS, Feedback, Expert judgment (from safety assessment)	RTS, debriefing and expert judgment (also linked to safety assessment), qualitative	Closed
HP2 Suitability of technical system in supporting the tasks of human actors	**HP2.1 Adequacy of allocation of tasks between the human and the machine (i.e. level of automation).**			N/A
	HP2.2 Adequacy of technical systems in supporting Human Performance with respect to timeliness of system responses and accuracy of information provided			
	222-001 (B)	RTS, Feedback, Measure+Analysis (cf. 1.3.2)	Observation, Qualitative, Transaction time measure	Closed
	HP2.3 Adequacy of the human machine interface in supporting the human in carrying out their tasks.			
	231-001 (I)	RTS and Feedback	Questionnaire and Observation, Qualitative	Closed
HP3 Adequacy of team structure and team communication in supporting the human actors	**HP3.1 Adequacy of team composition in terms of identified roles**			N/A
	HP3.2 Adequacy of task allocation among human actors			N/A
	HP3.3 Adequacy of team communication with regard to information type, technical enablers and impact on situation awareness/workload			
	332-001 (I)	RTS and Feedback	Questionnaire and Observation, Qualitative	Closed
	334-001 (I)	RTS, Feedback, Measure+Analysis (cf. 1.3.2)	RTS, questionnaire and expert judgment, qualitative and quantitative(workload)	Closed
	335-001 (I)	RTS and Feedback	Questionnaire and Observation, Qualitative	Closed
HP4 Feasibility with regard to HP-related transition factors	**HP4.1 User acceptability of the proposed solution**			
	412-001 (I)	Feedback	Questionnaire, Qualitative	Closed
	HP4.2 Feasibility in relation to changes in competence requirements			
	421-001 (I)	RTS and Feedback	Questionnaire and Observation, Qualitative	Closed
	HP4.3 Feasibility in relation to changes in staffing levels, shift organization and workforce relocation.			N/A
	HP4.4 Feasibility in relation to changes in recruitment and selection requirements .			N/A
	HP4.5 Feasibility in terms of changes in training needs with regard to its contents, duration and modality.			N/A

Table 10: HP arguments, activities and metrics

4.17.2Extrapolation to ECAC wide

It is expected that the same extrapolation will be applicable ECAC wide for the states which have demand for RPAS operations per the Accommodation concept.

4.17.3Open HP issues/ recommendations and requirements

PIs	Number of open issues/ benefits	Nr. of recommendations	Number of requirements
HP1 Consistency of human role with respect to human capabilities and limitations	Further assess RPAS in emergency situations	• No impact of communications latency (1 sec. / single RPAS)	• General training on RPAS functioning shall be provided to ATCO • RPAS number in one sector shall be limited to one at the same time. For a two RPAS scenario, RPAS flights must be coordinated and operator shall guarantee that C2LL trajectories are not in conflict,
HP2 Suitability of technical system in supporting the tasks of human actors		• Common C2LL transponder code alert mechanism to ATCOs on existing systems in case C2 link loss occurs (depending on flight route national or multi-states & existing ATM system) until 7400 is in place	• "REMOTE" added to callsign at the first radio contact
HP3 Adequacy of team structure and team communication in supporting the human actors		• Potential to optimise C2LL initial contact information	
HP4 Feasibility with regard to HP-related transition factors			• As for HP1 General training on RPAS functioning shall be provided to ATCO

Table 11: Open HP issues/ recommendations and requirements

EUROPEAN PARTNERSHIP

Co-funded by the European Union

4.17.4Concept interaction

As a reminder (cf. 3.2) PJ.13-W2-115 may be seen as a precursor in time to PJ.13-W2-117. PJ.13-W2-115 addresses procedural accommodation based on existing ATM systems and initial existing RPAS, whereas PJ.13-W2-117 independently addresses integration based on evolved ATM and RPAS systems/technologies and procedures.

4.17.5Most important HP issues

PIs	Most important issue of the solution	Most important issues due to solution interdependencies
HP1 Consistency of human role with respect to human capabilities and limitations	RPAS in emergency situations	Emergency management of single/low numbers of RPAS to be carried forward to long-term full RPAS integration (S117)
HP2 Suitability of technical system in supporting the tasks of human actors	NA	**NA**
HP3 Adequacy of team structure and team communication in supporting the human actors	NA	**NA**
HP4 Feasibility with regard to HP-related transition factors	NA	NA

Table 12: Most important HP issues

4.17.6 Additional Comments and Notes

NA

4.18 Other PIs

NA

4.18.1 Performance Mechanism

NA

4.18.2 Assessment Data (Exercises and Expectations)

NA

4.18.3 Additional Comments and Notes

NA

4.19Gap Analysis

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI)[6]	Rationale[7]
SAF1: Safety - Total number of estimated accidents with ATM Contribution per year	Safety Neutral	Safety Neutral	No increase in ER-MAC rate – No Gap identified
FEFF1: Fuel Efficiency - Actual average fuel burn per flight			
CAP1: TMA Airspace Capacity - TMA throughput, in challenging airspace, per unit time.			
CAP2: En-Route Airspace Capacity - En-route throughput, in challenging airspace, per unit time			
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).			
TEFF1: Gate-to-gate flight time			
PRD1: Predictability – Average of Difference in actual & Flight Plan or RBT durations			
PUN1: Punctuality – Average departure delay per flight			
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty			
CEF3: Technology Cost – Cost per flight			

Table 13: Gap analysis Summary

6 Negative impacts are indicated in red.

7 Discuss the outcome if the gap indicates a different understanding of the contribution of the Solution (for example, the Solution is enabling other Solutions and therefore is not contributing a direct benefit). **Please contact your PJ19.04 Solution Champion to clarify when the Gap Rational is needed.**

5 References

[1] 08.01.03 D47: AIRM v4.1.0

[2] B05 Performance Assessment Methodology for Step 1 PJ19.04.01 Methodology for Performance Assessment Results Consolidation (2020)

[3] SESAR Performance Framework (2019), Edition 01.00.01, Dec 2019

Performance Assessment and Gap Analysis Report (2019), Edition 00.01.02, Dec 2019

[4] Methodology for the Performance Planning and Master Plan Maintenance, Edition 0.13, Dec 2017

Content Integration

[5] SESAR ATM Lexicon

[6] Performance Management

[7] PJ19.04 D4.1 Validation Targets - Wave 2 (2020)[8]

Validation

[8] European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010]

[9] SESAR 2020 PJ13 Solution 115 VALR (Validation Report), Ed. 2.00.00, 10/10/2022

Safety

[10]SESAR, Safety Reference Material, Edition 4.0, April 2016

[11]SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016

[12]SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015

[13]Accident Incident Models – AIM, release 2017

[14] SESAR Solution 115 SPR-INTEROP/OSED for V3 - Part II - Safety Assessment Report, Ed. 00.02.00, 7/10/2022

Human Performance

[15]16.06.05 D 27 HP Reference Material D27

[16]16.04.02 D04 e-HP Repository - Release note

[17] SESAR Solution 115 SPR-INTEROP/OSED for V3 - Part IV - Human Performance Assessment Report, Ed. 00.02.00, 16/09/2022

8 At the time of the creation of the PAR template the Validation Target is foreseen to be delivered in June 2020

Environment Assessment

[18]SESAR, Environment Assessment Process (2019), PJ19.4.2, Deliverable D4.0.080, Sep 2019.

[19]ICAO CAEP – "Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes" document, Doc 10031.

Security

[20]16.06.02 D103 SESAR Security Ref Material Level

[21]16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[22]16.06.02 D131 Security Database Application (CTRL_S)

Appendix A Detailed Description and Issues of the OI Steps

OI Step ID	Title	Consistency with latest Dataset
AUO-0619	RPAS accommodation in class A-C airspace	Yes

Table 14: OI Steps allocated to the Solution

No issues