PJ PROSA

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Founding Members

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Authoring & Approval

Authors of the document

Name/Beneficiary	Position/Title	Date
Alessandro Manzo / ENAV	Solution Lead PJ10-05	11 October 19
Alexander Seybold / DFS	PJ10 Project Manager Deputy	17 October 19
Daniel Cario / DSNA	Solution Lead PJ10-02a	11 October 19
John Godsell / NATS	Solution Lead PJ10-01c, 02b, 06	11 October 19
Jörg Bergner / DFS	PJ10 Project Manager	11 October 19
Pascal Latron / Skyguide	Solution Lead PJ10-01a	11 October 19
Vilmar Mollwitz / DLR (AT-One)	Solution Lead PJ10-01b	11 October 19

Reviewers internal to the project

Name/Beneficiary	Position/Title	Date
Ádám Szöllősi / HC (FSP)	Primary PJ10 PoC	16 October 19
Alessandro Manzo / ENAV	Solution Lead PJ10-5	16 October 19
Bruno Patin / Dassault	Primary PJ10 PoC	16 October 19
Corinna Cortese / Leonardo	Primary PJ10 PoC	16 October 19
Daniel Cario / DSNA	Solution Lead PJ10-02a	16 October 19
Francois d'Humières / FRQ (FSP)	Primary PJ10 PoC	16 October 19
Jaroslaw Pielunowicz /PANSA (B4)	Primary PJ10 PoC	16 October 19
Johan Pellebergs / SAAB (NATMIG)	Primary PJ10 PoC	16 October 19
John Godsell / NATS	Solution Lead PJ10-01c, 02b, 06	16 October 19
Leticia Gonzalez / INDRA	Primary PJ10 PoC	16 October 19
Lukáš Vokoun / ANS CR (B4)	Primary PJ10 PoC	16 October 19
Michael Ipsen / COOPANS	Primary PJ10 PoC	16 October 19
Pablo Sánchez /ENAIRE	Primary PJ10 PoC	16 October 19
Pascal Latron / Skyguide	Solution Lead PJ10-01a	16 October 19
Philippe Tubery / Thales Air Sys	Primary PJ10 PoC	16 October 19
Raphael Pascal / Airbus	Primary PJ10 PoC	16 October 19
Stephan Herr / DFS	Primary PJ10 PoC	16 October 19
Stephen Morton / EC	Primary PJ10 PoC	16 October 19
Vilmar Mollwitz / DLR (AT-One)	Solution Lead PJ10-01b	16 October 19

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

Name/Beneficiary	Position/Title	Date
Ádám Szöllősi / HC (FSP)	Primary PJ10 PoC	25 October 19
Alessandro Manzo / ENAV	Solution Lead PJ10-05	24 October 19
Alexander Seybold / DFS	PJ10 Project Manager Deputy	25 October 19
Bruno Patin / Dassault	Primary PJ10 PoC	23 October 19
Corinna Cortese / Leonardo	Primary PJ10 PoC	25 October 19
Daniel Cario / DSNA	Solution Lead PJ10-02a	24 October 19
Francois d'Humières / FRQ (FSP)	Primary PJ10 PoC	25 October 19
Jaroslaw Pielunowicz /PANSA (B4)	Primary PJ10 PoC	25 October 19
Johan Pellebergs / SAAB (NATMIG)	Primary PJ10 PoC	25 October 19
John Godsell / NATS	Solution Lead PJ10-01c, 02b, 06	25 October 19
Jörg Bergner / DFS	PJ10 Project Manager	25 October 19
Leticia Gonzalez / INDRA	Primary PJ10 PoC	25 October 19
Lukáš Vokoun / ANS CR (B4)	Primary PJ10 PoC	25 October 19
Michael Ipsen /COOPANS	Primary PJ10 PoC	25 October 19
Pablo Sánchez /ENAIRE	Primary PJ10 PoC	25 October 19
Pascal Latron / Skyguide	Solution Lead PJ10-01a	24 October 19
Philippe Tubery / Thales Air Sys	Primary PJ10 PoC	25 October 19
Raphael Pascal / Airbus	Primary PJ10 PoC	25 October 19
Stephan Herr / DFS	Primary PJ10 PoC	25 October 19
Stephen Morton / EC	Primary PJ10 PoC	25 October 19
Vilmar Mollwitz / DLR (AT-One)	Solution Lead PJ10-01b	25 October 19

Rejected By - Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date
none		

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PJ10 PROSA

CONTROLLER TOOLS AND TEAM ORGANISATION FOR THE PROVISION OF SEPARATION IN AIR TRAFFIC MANAGEMENT

This final project report is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 734143 under European Union's Horizon 2020 research and innovation programme.

Abstract

This project is a part of the SESAR programme and addresses separation management. It aimed at providing air traffic controllers with more automated tools, thereby allowing them to concentrate on situations where human intervention is crucial. The project not only improved current conflict detection tools, but also develop new tools supporting the air traffic controller with resolution advisory and monitoring of flight trajectory. The project will addressed new ways of working together, taking into account developments such as drones.

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Executive Summary

Solution PJ.10-01a: High Productivity Controller Team Organisation

This solution sees the extension of sector team operations beyond the standard team structure of one Planner Controller (PC) and one Executive Controller (EC) in both En-Route and extended TMA, in order to optimise flight profiles, minimise delays and improve ANSP cost efficiencies while taking into account intrinsic uncertainty in the trajectory. The concept of MSP (1 PC – 2 ECs) in En-Route/eTMA (medium/high complexity) has reached V3 maturity and is ready for next step.
The concept of MSP in En-Route addressing a team structure with one MSP supporting more than two Executive Controllers (1 PC – 3 ECs) needs to be further investigated to prove the full feasibility and operational acceptability and to fully complete the V2 phase. In fact, the concept with one MSP supporting two Executive Controllers, tested in the transition scenario has been evaluated to be feasible and acceptable without any perceived degradation in the ATC service.

Solution PJ.10-01b: Flight Centric ATC

The objective of PJ.10-01b is the validation of Flight Centric ATC (FCA) in En-Route environment where a number of flights are assigned to a controller, unconstrained by geographical location, sector or national boundaries
Controllers felt during the validation runs that the HMI of the platform did not support their Situation Awareness, and mentioned problems with vertical movements, probing function and the filtering algorithm. In general, the need to better understand the intent of other controllers operating in the same area (electronic coordination) was identified as a key point for the implementation of the Flight Centric mode of operations. The analyses of the fast-time simulations show very positive results and operational feasibility for the transitions from/to FCA on the optimal number of air traffic controllers. In addition, FCA without enhanced automation was also found to have a positive impact on the optimal number of controllers.
Flight Centric ATC reached V2 maturity for areas that can be covered by a single VHF antenna in wave 1. It is planned to continue work in these environments in wave 2. For areas that cannot be covered by single VHF ground antenna, Flight Centric has not reached V2 in wave 1; a more detailed description of the Wide Area Communication concept including a safety assessment is expected to be delivered in 2020 for this environment to reach V2.

Solution PJ.10-01c: Collaborative Control

The solution investigates new operating procedures such that the traditional requirement to coordinate traffic at all sector boundaries is removed and constraints are only applied when a particular separation problem or traffic management demands. Tactical Controllers (in the same area of interest) collaborate and may issue clearances into, and even operate traffic within, others' AOR without prior co-ordination, in order to achieve overall profile targets set by the Planner Controller allowing the airspace to be used more freely and efficiently.
The results have demonstrated the feasibility of the concept, with positive ATCO feedback on workload reduction thanks to a reduced need for coordination and communications improvement in situation awareness and no safety incidents through support offered by the new HMI design and tools.
Further concept evolution should be oriented to the refinement of a mode of operation appropriate for high density En-Route environment in conjunction with the enhancement of trajectory prediction and the fine-tuning of supporting tools.

Solution PJ.10-02a: Improved performance in the provision of separation

General objectives of PJ.10-02a1 & PJ.10-02a2 are to improve and enhance work already performed in SESAR 1 with regards to controller tools for improved performance within separation management. While PJ.10-02a2 makes us of ADS-C/EPP data, other trajectory data is used for 10-02a1."
Based on the obtained results, it can be concluded that the improved separation management tools/functionalities of PJ.10-02a1 can work coherently together and are capable of delivering the required benefits and has reached V3 maturity. Nevertheless, in order to reach their full potential and to integrate them successfully into the target ATM, detailed analysis of the existing operational settings and accordingly tools' parameters adjustment is required.
Solution PJ.10-02a2 was operationally validated in En-Route environment. The conclusions on the performance, operability, technical feasibility and acceptability of the concept are based on real-time simulations and indicated readiness of the MTCD enhanced with ADS-C/EPP data to move to V3 maturity phase.
It is recommended to investigate the use of more precise trajectory prediction provided by ADS-C/EPP for the detection of En-Route wake encounters risks.

Solution PJ.10-02b: Advanced Separation Management

The solutions aims at validating advanced separation aids by providing new ATC assistance and more automated support tools, thereby advancing CD/R tools from information analysis to decision and action selection.
The majority of exercises assessed the tools and concepts sufficiently to complete V1 maturity. In the context of using ADS-C EPP data to support a CD/R tool, key issues include both the availability of a consistent/usable ADS-C EPP report, as well as the accuracy of the predicted climb/descent performance, which can be derived from it. This directly influences the level of confidence that a certain constraint is feasible. With regards to the performance assessments, initial results suggest the potential to positively impact human performance, safety, capacity, cost efficiency, predictability and the environment.
Recommendations for Wave 2 include ways to mature/improve acceptability/technical feasibility of the tool support developed, inclusion of RTS and increasing the scope of the operational environments.

Solution PJ.10-05: IFR RPAS Integration

Solution 10-05 IFR RPAS Integration was aimed at providing the procedural and technological means to safely integrate RPAS traffic in the non-segregated controlled airspace complying with ATC instruction. Accommodation of RPAS in the current controlled environment is also encompassed by this solution as a quick goal for deployment.
Validation activities performed in the context of 10.05 solution gave indications that the integration of RPAS flying IFR in medium complexity En-Route and TMA environment is feasible, but results achieved are not fully covering a V2 maturity solution. The expense of additional workload of the ATCOs with a consequent impact on airspace capacity was encountered, especially in the non-nominal conditions (e.g.: contingency procedures). In the future phases, improvements and clarification in both the operating methods and technical architecture will be needed. Contingency and emergency are important concepts to be well clarified. Delay in communication is a central issue for RPAS Integration, and definition of quantified requirement is expected in next phase. In contingency situation, the additional workload and the impact of a new airspace user such an RPAS, has potential consequences on traffic capacity. Manned traffic may be impacted from a capacity point of view in those conditions. 10-05 will be continued in SESAR Wave 2 in the context of PJ13.

Solution PJ.10-06: Generic' (non-geographical) Controller Validations

The objective is to identify the human, system and procedural needs that might allow a more flexible ATCO validation regime, for example "sector-type validations" that would allow a controller to operate in any airspace classified as a particular type.
Results showed that, without additional support, Generic controllers found it difficult to plan traffic in an expeditious, efficient and safe manner within unfamiliar sectors. The concept was found to have a large impact on human performance, with controllers stating that it was difficult to maintain situational awareness as visual scanning and task prioritisation is different in each sector.
Initial feedback suggests there will be a trade-off between the improvement in cost efficiency due to more flexible ATCO rostering and the cost efficiency of individual controllers which in turn means an impact on the Capacity KPA.
It is currently expected that work being conducted in Wave 2 will comprise two threads, dealing with NGCV "Within ATC Centre" and "Across ATC Centre / ANSP".

1 Project Overview

Solution PJ.10-01a: High Productivity Controller Team Organisation

PJ.10-01a encompasses the investigation of new controller team organisation and in particular focusing on the Multi Sector Planning organisation in complex En-Route and eTMA environment. Therefore objective is to define operational concept, validate the new proposed configuration. One Planner Controller covering the area of two Executive Controllers in eTMA environment and One Planner Controller covering the area of three Executive Controllers in En-Route environment were assessed. The airspace addressed in PJ10.01a is high density/complexity extended TMA and En-Route Environment.

Solution PJ.10-01b: Flight Centric ATC

PJ.10-01b encompasses the investigation of Flight Centric ATC where the idea is to dissolve sector boundaries so one controller is no longer in charge of managing the entire traffic within a given sector, but is now responsible for a certain number of aircraft throughout their flight segment within a given airspace whereas other controllers are responsible for different aircraft within the same airspace.

Solution PJ.10-01c: Collaborative Control

Collaborative Control refers to coordination by exception rather than coordination by procedure and is enabled by advanced controller tools, supporting a reduced need for coordination agreements. Fewer boundary constraints may be required; and where initial boundary constraints are required for separation management, efficiency or complexity management purposes, these can be flexibly bypassed if the air traffic situation allows. Collaborative Control includes (implies) the ability to pass into the airspace under the jurisdiction of another controller without a prior release being agreed explicitly (as long as both ATCOs are aware of the traffic situation and maintain the ability to separate their traffic).

Solution PJ.10-02a: Improved performance in the provision of separation

PJ10-02a is split in two sub-solutions (PJ10-02a1 & PJ10-02a2) aiming at improving the separation in the En-Route and TMA operational environments through improved ground trajectory prediction. This is achieved using, respectively existing information on lateral and vertical clearances that are known by the ground system and airborne information such as Mode S data (PJ10.02a1) and existing information on lateral and vertical clearances that are known by ADS-C/EPP airborne information (PJ10.02a2).

Solution PJ.10-02b: Advanced Separation Management

Solution PJ.10-02b aims at further increasing the quality of service in advanced separation management by providing a higher level of automation in the decision support tools and further improving the prediction of separation tools. To exploit the potential of higher automation levels and more available information, improvements in controller Human Machine Interface are also foreseen.

Solution PJ.10-05: IFR RPAS Integration

SESAR Solution 10-05 provides the technical capability and/or procedural means to allow a Remoted Piloted Aircraft System (RPAS) to be integrated into the ATMS safely.
One basic principle underpinning the integration of RPAS, in alignment with ICAO principles, is that RPAS must be treated in a similar manner to manned aircraft while duly considering the specific

character of remotely manned operations. RPAS operations will affect sector/operational capacity, but this dependency will be linked to several factors, such as the numbers of RPAS flying simultaneously in an area, the type/complexity of their operations, the separation standards they require (RVSM or non-RVSM) and the latency related voice communication and C2 link, in particular for BRLOS being experienced with them.
RPAS operations must be compliant with aviation regulations, and their integration into the ATMS should not impact unacceptably on current airspace user operations and levels of safety and capacity. RPAS behaviour should therefore be equivalent to manned aviation and should comply with the CNS requirements applicable to the class of airspace within which they are intended to operate. RPAS should also comply with evolutions in the ATM operational concepts currently being researched within SESAR (e.g. trajectory management) as they are deployed

Solution PJ.10-06: Generic' (non-geographical) Controller Validations

The SESAR Solution PJ.10.06 looks to identify the human, system and procedural needs that might allow a more flexible ATCO validation regime, for example "sector-type validations" that would allow a controller to operate in any airspace classified as a particular type.

1.1 Operational/Technical Context

Solution PJ.10-01a: High Productivity Controller Team Organisation

PJ.10-01a investigates new controller team organisation and in particular focusing on the Multi Sector Planning organisation in complex environments.
A controller team having one Planner Controller working on an area (sectors) controlled by 2 Executive Controllers (3 in the case of ENAV exercise) was addressed.
As PJ.10-01a addressed two maturity levels on different operational environments, the operational context encompasses high complexity eTMA (PJ.10-01a1) and high complexity En-Route (PJ.10-01a2) environments.
Controller Support Tools (i.e CDTs, MONA, Electronic Coordination) have been adapted to fit with the new organisation and task sharing, focus has been also on Controller Working position organisation and HMI.

Solution PJ.10-01b: Flight Centric ATC

PJ.10-01b investigated Flight Centric ATC in low, medium, high and very high complexity En-Route environment.
The problem addressed is the idea of Flight Centric ATC, where sector boundaries are dissolved so one controller is no longer in charge of managing the entire traffic within a given sector, but is now responsible for a certain number of aircraft throughout their flight segment within a given airspace whereas other controllers are responsible for different aircraft within the same airspace.

Solution PJ.10-01c: Collaborative Control

The new operating method is designed to facilitate better aircraft profiles (in particular, earlier and more continuous climbs) through collaborative use of airspace, making this explicit tactical coordination/re-coordination 'on demand', rather than by procedure.
PJ.10-01c investigated the applicability conditions of the Collaborative Control concept to very-high complexity TMA and the transition phase between En-Route-TMA interface airspace to high complexity.

Solution PJ.10-02a: Improved performance in the provision of separation

PJ10-02a addresses possible improvement of conflict detection tools resulting from the enrichment of the trajectory.
PJ10-02a1 investigated separation and conflict detection services in low to very high complexity, in TMA and En-Route environment. Free Route and Fixed Route are addressed. Different trajectory enrichment are addressed, except ADS-C/EPP data.
PJ10-02a2 investigated separation and conflict detection services in low to very high complexity, in En-Route environment. Fixed Route only is addressed. In this solution, only trajectory enrichment by ADS-C/EPP data is addressed.

Solution PJ.10-02b: Advanced Separation Management

The operational environment is En-Route and TMA (medium to very high complexity).

Solution PJ.10-05: IFR RPAS Integration

PJ.10-05 solution was aimed at investigating ways in which RPAS may be able to use technical capabilities or procedural means to be safely integrated in the En-Route and Terminal ATM areas (A-C airspaces). Operating method must be compliant with the current ATC instructions, in order to be integrated in non-segregated and controlled airspaces where they may operate under Instrument Flight Rules (IFR).

Solution PJ.10-06: Generic' (non-geographical) Controller Validations

In current operations for all European ANSPs working under reg (EU) 2015/340, a controller holds a rating entitling them to work on a category of airspace (e.g. Area, Approach or Tower) in addition to a unit endorsement enabling them to work on a number of particular sectors or units.

The SESAR Solution PJ.10-06 Non-Geographic Controller Validation (NGCV) investigated the possibility of moving away from the current operating method to one in which controllers hold a rating entitling them to work a particular type of airspace (yet to be defined but likely to be based on complexity, type and level of traffic). This, in turn, aims to remove the constraint that the controller must rely on a detailed knowledge of the sector and moves towards a more flexible approach whereby environmental knowledge and other information needs are supported by systems, procedures, airspace, training and regulatory adaptations whilst maintaining the ability of the controller to perform their task. At V1, the operational environment being considered is En-Route and TMA (but not including Approach Control (APP) – although APP may be considered at a later date).

1.2 Project Scope and Objectives

Solution PJ.10-01a: High Productivity Controller Team Organisation

This solution sees the extension of sector team operations beyond the standard team structure of one Planner controller (PC) and one executive controller (EC) in both En-Route and extended TMA, in order to optimise flight profiles, minimise delays and improve ANSP cost efficiencies while taking into account intrinsic uncertainty in the trajectory. The core of the solution consists of validating a concept of operation addressing an evolution of the current team configuration, in particular an evolution of the role of the Planner Controller, who will be responsible for a larger area and will serve two or more Executive Controllers.

Solution PJ.10-01b: Flight Centric ATC

The objective of PJ.10-01b is the validation of Flight Centric ATC in En-Route environment where a number of flights are assigned to a controller, unconstrained by geographical location, sector or national boundaries:

- validation of procedures for conflict detection and resolution including procedures for non-standard situations (emergency, weather...);
- validation of workload and increase of controller productivity quantifying expected benefits;
- consideration of procedures for flight optimisation and harmonization with local flow management;
- validation of different aircraft-to-controller assignment strategies.

Solution PJ.10-01c: Collaborative Control

New operating procedures are in place such that the traditional requirement to coordinate traffic at all sector boundaries is removed and constraints are only applied when a particular separation problem or traffic management demands. The Tactical Controllers (in the same area of interest) collaborate and may issue clearances into, and even operate traffic within, others' AOR without prior co-ordination, in order to achieve overall profile targets set by the Planner allowing the airspace to be used more freely and efficiently.
New opportunities for the utilisation of operational staff - including new roles for the Tactical and Planning Controllers within the team - are offered along with the increasing sophistication of ATC support Tools. This will continue to provide improvements in cost effectiveness and will result in better profiles for aircraft resulting in greater fuel efficiency and predictability.

- To investigate the impact of collaborative control when procedures are put in place to manage the reduction of co-ordination agreements between En-Route and TMA
- To research the collaborative control concept when it is paired with advances in controller tools support
- To develop and validate performance requirements for tools support for different grades of collaborative control practice

Solution PJ.10-02a: Improved performance in the provision of separation

General objectives of PJ.10-02a are to improve and enhance work already performed in SESAR 1 with regards to controller tools for improved performance within separation management.
For En-Route :

- Enhance Conflict Detection and Resolution tools and concepts coming from SESAR 1 activities, including the use of improved trajectory data.
- The procedures and requirements for the Free Route environment will be taken into account (PJ.06).
- Evaluate interaction between MTCD and Tactical Controller Tools (TCT).
- Implement an optimised conflict resolution system considering flight efficiency and providing best service for flights contributing the most to predictability and conformance monitoring considering the improved ground trajectory prediction taking into account performance of EPP from PJ.18.
- Assist controllers in their separation tasks by enhanced tools with improved technical functionalities and innovative HMI features.
- Develop and validate performance requirements for separation tools, including the underlying trajectory prediction.

For TMA:

- Develop conflict detection and resolution assistance solutions reaching TRL4/V2 in 2018 and TRL6/V3 in 2019.
- Improve TCT with special emphasis on TMA operational environment.

Solution PJ.10-02b: Advanced Separation Management

Increasing the quality of service of separation management in the En-Route and TMA operational environments (for example by reducing control workload, reducing separation buffers or facilitating new controller team organisations)

- Automation mechanisms will be introduced (i.e. vertical and longitudinal separation will be ensured by interventions recommended by the automated system, that have to be confirmed by controllers and in exceptional cases by controller intervention)
- Controllers will be assisted in their separation tasks by tools that make use of advanced data (for example EPP and Area of Responsibility (AOR) information) that increase the quality of provided services. These services comprise further improved ground trajectory prediction, resolution support increasing flight efficiency to allow for prioritisation, automated aspects of conflict resolution/dilution applied to mixed equipped fleet as well as an improved conformance monitoring that takes into account the calculated ground system trajectories

Solution PJ.10-05: IFR RPAS Integration

Solution 10-05 IFR RPAS Integration was aimed at providing the procedural and technological means to safely integrate RPAS traffic in a non-segregated controlled airspace (En-Route and Terminal ATM areas), complying with ATC instruction. The objective was to find out appropriate integration solutions which may support and ease ANSP's task to guarantee a high level of safety and efficiency also in mixed manned and unmanned traffic. Safety and Human Performance in nominal and not nominal conditions were also subject of the solution analysis.
Additional operational and technical characteristic investigated in the context of 10-05 include the following aspects that were included in the validation activities analysis:

- Impact of the latency in communication in a ‘voice plus CPDLC’ environment considering the BRLOS operations and sat link in En-Route;
- Interaction and consistency of RPAS contingencies with ‘manned operations emergency situations in En-Route;
- Integration of class VI RPAS in non-segregated TMA (medium Density/Medium complexity) using SID and STAR;
- Assessment on contingencies related to loss of C2 link and communication link;
- React of RPAS to ATCO vectoring in TMA operations considering the delay in communication;
- Provide experience and data to support validation of DAA capabilities for cooperative collision avoidance in controlled airspace;
- Explore lost separation and collision scenarios using DAA system on the RPAS in controlled airspace;
- Assessment of main KPAs: Safety and Human Performance considering the participation of human actors (ATCOs, Remote Pilots) to validation activities;
- Provide experience and data related the HMI (Controlled working position/ Remote pilot station).

Solution PJ.10-06: Generic' (non-geographical) Controller Validations

Advanced automation support allows controllers to hold more generic validations (e.g. moving to validation according more to airspace type and tool-set) rather than validations based purely on specific (geographic) sectors.

- The objective is to identify the human, system and procedural needs that might allow a more flexible ATCO validation regime, for example "sector-type validations" that would allow a controller to operate in any airspace classified as a particular type.

1.3 Work Performed

Solution PJ.10-01a: High Productivity Controller Team Organisation

To address the operational concept of Multi Sector Planning, several activities have been performed.
Initial activity was to assess the current status of the Multi Sector Planning concept taking into account results from SESAR 1 and also current implementations. In particular, the MSP concept is already in operation in some TMAs (e.g. Copenhagen, Stockholm, Munich…). Based on this initial activity, the scope of the solution has been refined and new plan and objectives have been set-up.
Solution has been split into two sub-solutions, one addressing MSP concept in En-Route (High/very high complexity) (1PC – 3ECs) at V2 level and another sub-solution addressing MSP concept in Extended TMA (eTMA, medium/high complexity) (1PC – 2ECs) at V3 level.
Two validations have been performed to cover both sub-solutions delivering results to assess the maturity of the MSP concept in both environments.
The MSP concept has been validated on two different technical platforms (IBP).

- The eTMA environment (Zurich eTMA) was simulated on the skyguide IBP, four sectors were manned for validation plus adjacent sectors as feeder
- The En-Route environment (Roma ACC sectors) was simulated on the ENAV IBP provided by Leonardo, three sectors were manned for validation plus adjacent sectors as feeder.

Operational concept, Safety activities, Human Performance activities, Performance activities, Security activities, CB and Technical activities have been carried out.
All deliverables (OSED-SPR/INTEROP, TS/IRS) have been addressed at V2 (En-Route) and V3 level (eTMA).

Solution PJ.10-01b: Flight Centric ATC

PJ.10-01b conducted workshops, fast-time simulations and real-time simulations on research platforms and pre-industrial prototypes in V1 and V2 phases. Flight Centric ATC was investigated in four validation exercises that covered the following areas:

- Budapest ACC between FL325 and FL660
- Madrid ACC from GND to UNL (excluding all airports and Madrid TMA)
- ATC sectors Heide, Aller, Hamburg West, Hamburg East (within Bremen ACC) between Fl105 and FL245
- Prague ACC at all altitudes, finding the lower boundary down to which Flight Centric ATC can be applied was part of this validation exercise

Solution PJ.10-01c: Collaborative Control

Two validation exercises were completed, as described below:

- EXE-001 (NATS): executed in a Very High Complexity TMA (London TMA) sub-operating environment – focused on the validation of the Collaborative Control with **planned boundaries**

operating method. The exercise was planned to address the use of the concept for SPO operations within the tactical horizon (CM-0309);

- EXE-002 (ENAIRE): addressed the operating method for Collaborative Control with **unplanned boundaries** in High Complexity En-Route/TMA Interface airspace using MSP configuration. The selected geographical scenario was Madrid En-Route and TMA airspace (CM-0306).

Solution PJ.10-02a: Improved performance in the provision of separation

Two threads of validation were completed for 10-02a1. One thread including two exercises was completed for 10-02a2.

- 1st thread for 10-02a1 included :

1. One fast-time simulation: Modelling the relationship between TP accuracy, MTCD performance and controller workload with the aim of defining required minimum performance specifications for CD&R tools, to enrich TP improvement study performed through PJ18-06 (Eurocontrol, ANS-CR).
2. Four real-time simulations :
    1. En-Route Separation management with an MTCD using improved trajectory data, such as wind data and improved HMI (DSNA)
    2. TC Aid developed through SESAR1 by DFS tested over a new TMA environment over Copenhagen.
    3. Building and testing of predictive models based on significant ATC intent (subtle factors) and TMA data in the separation management and provision of an HMI displaying the information to the tactical controller. This was a three steps exercise, including a first FTS with an expert paper analysis and the final RTS (PANSA).
    4. Tactical encounter solver assistant (TESLA) tool for separation management in TMA environment, speeding up the controllers' decision making related to the tactical problem solving. It will provide a range of resolution assistance functionalities based on trajectory prediction and conformance monitoring (BULATSA, Airbus D&S).

- 2nd thread for 10-02a1 included six real time simulations :

1. "CD&R Aids in En-Route upper sectors focus on MTCD in En-Route" performed by DSNA. This exercise focuses on the assessment of an enhanced MTCD with detection of conflict between Aircraft-Volume with high traffic density. This activity addressed 10.02a1.
2. "COOPANS/Thales Tactical Controller Tool (TCT) for conflict detection and resolution optimization in TMA" performed by COOPANS and Thales. The exercise focuses on understanding to which extend the new TCT tools will positively impact the controller's task performance in conflict detection and resolution in TMA and extended TMA airspace with high traffic density including a high percentage of vertical movements. This activity addressed 10.02a1.
3. "CD&R aids in Free Route Environment" performed by ENAV. The ENAV En-Route & TMA platform is used to perform a real time simulation in En-Route operational environment with free route structure. This activity addressed 10.02a1
4. "Controller Support Tools (CDT – MONA)" performed by skyguide. The exercise focuses on assessing the Controller Support Tools and Monitoring Aids adapted to a Free Routing environment on Predictability, Capacity, Safety and Human Performance. This activity addressed 10.02a1.
5. "Early Conflict Resolution Using Enhanced CD&R Tools" performed by ECTL, ANS-CR, Thales. The exercise addresses an enhanced working method, enabled by more reliable CD&R tools

(achieved by more accurate trajectory prediction), that is expected to reduce executive controller workload. This activity addressed 10.02a1.

6. "CD&R and enhanced conformance monitoring for TC and PC" performed by Airbus D&S and BULATSA. TMA separation management and transition to En-Route sectors with TESLA tool taking into account the results from the V2 phase. TP improvement in V3 will address combination of calculated system trajectories enhanced with aircraft derived data (EPP emulation). This exercise addresses both solutions 10.02a1 & 10.02a2.

- The two exercises performed for 10-02a2 were :

1. "PC-Aid tool integrated on iTEC platform for conflict detection aid using EPP performed by PANSA and INDRA. The exercise focuses on assessment of planner tool, detecting conflicts relevant to the planner controller responsibilities using new TP algorithms and EPP data. This activity addresses 10.02a2.
2. "CD&R and enhanced conformance monitoring for TC and PC" performed by Airbus D&S and BULATSA. TMA separation management and transition to En-Route sectors with TESLA tool taking into account the results from the V2 phase. TP improvement in V3 will address combination of calculated system trajectories enhanced with aircraft derived data (EPP emulation). This activity addressed both solutions 10.02a1 & 10.02a2.

All deliverables (OSED-SPR/INTEROP & all its appendices, TS/IRS, CBA & VALR) have been addressed at V2 and V3 level for 10-02a1.
The deliverables at V3 level included sections at V2 level for 10-02a2

Solution PJ.10-02b: Advanced Separation Management

During the V1 phase a series of six validation exercises were designed investigating the various concepts using a range of validation techniques. These exercises include the following:

- EXE-001 – Investigated the Enhanced Tactical Window, Dependency Tool and Recommendation Tool. The validation used three stakeholder workshops including a demonstration activity at the simulator (second workshop) and debriefing discussions.
- EXE-002 - The concept explored flight conformance monitoring and resolution advisories using PBN routes with vertical constraints. The validation was performed as a workshop together with controllers and an Expert User Group.
- EXE-003 - Explored uses of EPP data to support automated conflict resolution support tools. The validation used a series of workshops supported by analytical studies.
- EXE-004 – Assessed "What-next" functionality, weather geo-fencing functionality and the use of EPP data as a technical enabler. These were validated through two pathfinding workshops with the participation of operational stakeholders.
- EXE-005 – Assessed a tool which acted as an automated trajectory and route-based conflict resolution advisory. This included development phase workshops and a simulation.
- EXE-006 – Investigated the automated separation management definition through generic task allocation between human operators and systems. Two workshops involving controllers, ground systems and avionics experts took place.

Solution PJ.10-05: IFR RPAS Integration

Solution 10-05 included a V1 and a V2 phase in which the following validation exercise were performed to achieve the expected level of maturity.
V1 phase included:

- EXE 10.5-V1-001. The exercise was made up of four incremental small-scale validation exercises (PRTS) and simulated RPAS operations in representative operational contexts to

assess the concept's operability and the acceptability of operational aspects in nominal and non-nominal conditions. Identification of major issues and needs for further validation in V2.

- EXE 10.5-V1-002. The exercise was made up of four incremental small-scale validation exercises (MBFTS) and simulated RPAS operations in representative operational situations to formulate minimum performance requirements of RPAS performing instrument procedures in TMA.
- EXE 10.05-V1-005. The exercise was a Real Time Simulation in Bordeaux-Merignac Airport (LFBD). RPAS were integrated with cooperative traffic within LFBD TMA (Class A, C and D). The objective was to assess the impact of dedicated RPAS procedures (nominal, abnormal and contingency) within a mid-density, mid-complexity TMA environment.

V2 phases included:

- EXE 10.05-V2-001 (Real Time Simulation): RPAS integration in En-Route IFR operations built on the outcome of the preceding V1 EXE 10.05-V1-001. It further investigated the integration of RPAS operations in a non-segregated En-Route airspace. The regarded environment was based on the Italian Maltese cross-border airspace. This exercise aimed to review the working method, operational needs and issues identified in V1 and proposed in a 2-man operation environment (executive plus planning controller).
- EXE 10.05-V2-002 (Real Time Simulation): RPAS non segregated integration in Italian TMA. This V2 validation exercise explored the possibility of integrating RPAS class VI aircraft in a non-segregated Italian TMA (Medium Density/Medium Complexity). In detail two different TMA sectors + En-Route (feeder sectors) geographically localized in Sardinia area, were part of the exercise.
- EXE 10.05-V2-004 (Real Time Simulation): RPAS flying in class C airspace and equipped with a DAA system with Situation Awareness and Collision Avoidance function. The exercise explored lost separation and collision scenarios by the use of DAA system on the RPAS to provide the remote pilot with situation awareness and collision avoidance functions.

Solution PJ.10-06: Generic' (non-geographical) Controller Validations

The V1 joint validation exercise with NATS, skyguide and LFV, consisted of a two day workshop, aiming to refine the concept, understand the Research and Development needs, gain understanding of the human performance, safety and performance benefits/impacts to develop it in preparation for Wave 2 activities.

On day one, three different validation techniques/aids were utilised: real time simulation, paper-based gaming and radar replay to elicit feedback on what issues are encountered when a controller works in an unfamiliar or "generic" sector. Controllers simulated controlling aircraft in a sector of one of the other ANSPs, acting as a "Generic" controller in an unknown airspace, supported by an "Expert" controller, valid on the airspace in their home Unit. This was performed using a number of scenarios in Very High Complexity TMA and En-Route operational environments and in runs with and without "expert" support. Day two of the validation exercise was performed via a brainstorming workshop session. Key issues that were identified in day one were collated, in addition to causes of these issues. Over the course of the validation exercise, potential impacts on a range of human performance impact areas were collected. These included potential impacts on roles and responsibilities, procedures, human error, task efficiency, workload, controller acceptability, situational awareness, team structure, teamwork and communication, training, recruitment and selection and staffing. In addition, the potential level of automation that may be introduced with the adoption of the generic controller validation concept was investigated as well as an understanding of the benefit and impact mechanisms with respect to safety and cost efficiency.

1.4 Key Project Results

Solution PJ.10-01a: High Productivity Controller Team Organisation

Two different maturity levels have been achieved to cover En-Route and eTMA MSP concept.
V2-ongoing Maturity : *CM-0303 - Sector Team Operations Adapted to New Responsibilities in En-Route, 1 Planning to several Tactical Controllers team structure*
One validation exercise (Real Time Simulation) in high complex En-Route environment with Free Route has been performed in Roma ACC
The MSA operations with one MSP supporting 3 ECs have not been considered fully feasible and operationally acceptable under the tested environment and traffic conditions. Some HMI features and tools implemented to support the controllers in the MSA operations also need to be improved to allow the deployment within the targeted ATM environment.
In addition, the tested configuration of one MSP supporting 2 ECs (in the transition scenario) has been considered acceptable without any perceived degradation in the ATC service but with some improvements to be implemented, related to roles and responsibilities to be better clarified, operating methods to be refined and HMI functionalities need some adaptations to better meet ATCOs requirements.
V3 Maturity: *CM-0304b - Sector Team Operations Adapted to New Responsibilities in eTMA, 1 Planning to several Tactical Controllers team structure*
The OI CM-0304b has been validated at solution level can be considered as V3 maturity.
One validation exercise (Real Time Simulation) in medium/high complex eTMA environment has been performed in Zurich ACC
The concept of the Multi Sector Planning in eTMA with supporting tools and functionalities is established at the generic level for similar operational environment and complexity. The conclusions on the performance, operability, technical feasibility and acceptability of the concept have been drawn out based on the results obtained through real-time simulation using a specific IBP, pre-industrial prototype platform.
Taking into account results from SESAR 1 concerning the MSP in En-Route (1PC – 2ECs), the concept of MSP in En-Route and in eTMA is considered to have reach V3 maturity. OIs CM-0303a complement CM-0304b.

Solution PJ.10-01b: Flight Centric ATC

Flight Centric ATC reached V1 maturity in December 2018. It reached V2 maturity for areas that can be covered by a single VHF antenna in wave 1. For areas that cannot be covered by single VHF ground antenna, Flight Centric has not reached V2 in wave 1; a more detailed description of the Wide Area Communication concept including a safety assessment is expected to be delivered in 2020 for this environment to reach V2.
Controllers felt during the validation runs that the HMI of the platform did not support their Situation Awareness, and mentioned problems with vertical movements, probing function and the filtering algorithm. These will need to be further improved in wave 2. In general, the need to better understand the intent of other controllers operating in the same area (electronic coordination) was identified as a key point for the implementation of the Flight Centric mode of operations.
The analyses of the fast-time simulations show very positive results and operational feasibility for the transitions from/to Flight Centric ATC on the optimal number of air traffic controllers. In addition, Flight Centric ATC without enhanced automation was also found to have a positive impact on the optimal number of controllers. A suitable transition strategy for time based transition from Flight Centric ATC to conventional mode of ATC operations was found. It is based on off line workload prediction and traffic flow analyses.

Solution PJ.10-01c: Collaborative Control

EXE-001 (NATS): The results have demonstrated the feasibility of the concept, with positive ATCO feedback on workload reduction thanks to a reduced need for coordination and communications improvement in situation awareness and no safety incidents through support offered by the new HMI design and tools. Consequently the concept merits further investment to mature the solution within Wave 2 of SESAR 2020, with the focus on several areas. These areas are roles and responsibilities with different staffing configurations (e.g. Planner controllers, MSPs and Coordinators), planning support through the controller toolset and HMI design, filtering of probed trajectories encounters, operational procedures and the quantification of quantitative benefits.
EXE-002 (ENAIRE): The ATCOs involved in the simulation agreed on the viability of the new concepts in terms of reduction of coordination and communications as well as quality of service, but with reregarding its applicability in En-Route / TMA Interface. They also expressed some concerns in relation to the current state of the HMI of the new system and supporting tools that impose additional workload and undermine situation awareness. Further concept evolution should be oriented to the refinement of a mode of operation appropriate for high density En-Route environment in conjunction with the enhancement of trajectory prediction and the fine-tuning of supporting tools.

Solution PJ.10-02a: Improved performance in the provision of separation

10-02a1 : Based on the analysis through the two thread of exercises, it is possible to conclude that this solution brings important benefits for a reasonable investment costs and **has reached V3 maturity**.
The main conclusions with regard to the validated tools and functionalities are:

- The MTCD service shall be designed in consistency with TCT and What-if service as an overall eco-system of ATC tools
- MTCD and What-if offered better ATCO situational awareness and decision-making support.
- Adapted to Free Route high complexity environment, Trajectory Management tools, Conflict Detection and resolution tools, Monitoring Aids and Electronic Coordination, improved situation awareness of controllers
- The use of RTE VIA (tool to de-conflict with close clearances) by the planner controller indicated possible safety benefits in terms of earlier resolution, better predictability and greater separation margins. In addition, the RTE VIA was shown to be helpful to reduce executive controller workload, particularly in busy traffic.
- The probing tool was found essential in FRA environment, especially in high density traffic
- From a technical perspective, the improved TCT, MTCD, RTE VIA and What if services were effective in supporting the controller in managing the traffic

10-02a2 : Based on the analysis through both exercises conducted, it is possible to conclude that this solution is technically and operationally feasible, bringing high benefits and has reached V2-ongoing maturity. The main conclusions with regard to the validated tools and functionalities are (some *are shared with the twin solution 10.02a1)*:

- The MTCD service shall be designed in consistency with TCT and What-if service as an overall eco-system of ATC tools
- MTCD offered better ATCO situational awareness and decision-making support.
- It is operationally feasible and beneficial to enhance MTCD with TP improved with EPP. Further work is required to ensure that ATM data containing EPP information is well presented to ATCOs in an operational setting.
- From a technical perspective, the MTCD enhanced with EPP data was effective in supporting the controller in managing the traffic. The results also indicate that the integration of the MTCD enhanced with ADS-C/EPP data is feasible.

Solution PJ.10-02b: Advanced Separation Management

A summary of the key results from the six PJ.10-02b exercises is described below:

- **Working Methods/Procedures:** The validation exercises identified that with the majority of the assessed tools working methods / procedures would be consistent with current operations. Exceptions to this included weather geo-fencing, tools using high levels of automation and potentially pilot procedures (regarding complex clearances with vertical constraints);
- **Task Performance:** Regarding controller task performance, tasks are expected to be improved in terms of time performance. However, further concept development work going forward will need to ensure that time remains a key performance requirement;
- **Roles and Responsibilities:** The exercises showed that fundamentally the controller roles will not change but certain exercises reported that there would be a change in the task distribution between the Tactical Controller and Planner Controller;
- **Workload:** Overall, it is expected there is a reduction in the cognitive tasks of controllers leading to a workload decrease when using a CD/R tool. In addition, a series of factors that could affect workload were identified. The exercises found the CD/R tools supported situational awareness hence helped the controller maintain a mental model. However, tool support needs to avoid information overload to not negatively impact situational awareness, team communication and the mental model. The aircrew situational awareness should also be improved thanks to a better view of the future evolution;
- **Situational Awareness:** The effects of increased automation on situational awareness will need to be considered in future development work. Higher levels of automation move the controllers role towards monitoring which could impact situational awareness;
- **Trust:** Controllers proposed that to build trust the tools could start with large buffers in the underlying conflict detection and resolution algorithms and gradually reducing them as trust improves. In addition, there is the risk of over trusting the system which can eventually lead to decreased situational awareness. However, there is also the risk of double-checking the solutions (if there was not sufficient trust) which may lead to increased workload;
- **Safety:** In terms of Safety there was seen to be a positive effect due to improved situational awareness. Although the increasing volume of traffic that advanced CD/R tools enable will need to be considered in future work in order to ensure safety is maintained at higher traffic levels;
- **Capacity:** Capacity was assessed qualitatively with feedback suggesting that airspace capacity would be improved through reduced workload when using the advanced CD/R tools. In addition, various factors that could impact workload (hence capacity) were identified;
- **Cost Efficiency:** The ATCO Productivity component of Cost Efficiency is directly related to controller workload hence this result also means an improvement in this metric. Also, technology costs depend on the level of automation. It is expected that the higher up the automation scale required to deliver this solution, the higher the technology cost will be;
- **Predictability:** Predictability was assessed in terms of the controller's ability to plan ahead rather than the SESAR KPA definition of variation between planned and actual flight durations. The exercises showed that the CD/R tools enabled the controllers to achieve earlier detection and avoidance of possible conflict situations;
- **Fuel Efficiency:** Fuel Efficiency results were positive showing the potential for improvements due to improved flight profiles. Due to the nature of the validation techniques used at V1, the results are not quantified and a more detailed analysis will be conducted at V2 to confirm the conclusions.

Solution PJ.10-05: IFR RPAS Integration

The validation activities performed in the context of 10.05 solution gave indications that the integration of RPAS flying IFR in medium complexity En-Route and TMA environment may be considered feasible even if there are a number of aspects to be still investigated and consolidated, which implied that this solution was not still considered at a V2 level of maturity.

The impacted enablers and the technical architecture should be better defined in next phases, even considering the difference between integration and accommodation requirements which are currently not fully clarified. Other aspects, like safety impact and CBA shall be improved.

Regarding the operational concepts, even though controllers and remote pilots' feedback were positive, there are still topics to be improved. Latency in communications is a key aspect to be considered. Even though validation activities produced considerations in the delay in both en-rout and TMA environment[1], specific requirement for acceptable delay should be defined.

When operations occurred in nominal conditions, they could be managed with a level of Safety equivalent to the current situation; in non-nominal conditions, controllers raised the level of complexity and triggered some Safety relevant situations.

RPAS related contingency and emergency were deemed as very important aspects for a safe integration and the clarification of the procedure will be needed in the future activities.

Alignment with the current regulatory framework need further clarifications and improvements

Solution PJ.10-06: Generic' (non-geographical) Controller Validations

Results showed that, without additional support, Generic controllers found it difficult to plan traffic in an expeditious, efficient and safe manner within unfamiliar sectors. Procedures, working methods, coordination and local geographical information all vary greatly sector to sector. The concept was found to have a large impact on human performance, with controllers stating that it was difficult to maintain situational awareness as visual scanning and task prioritisation is different in each sector and, as a result, this increased the concentration required, workload and the pressure to perform well. Generic controllers also stated that appreciation of the adjacent sector is important. By not having an understanding of adjacent traffic picture/flow and working methods, this can cause an unnecessarily higher team workload.
With regards to safety, Generic controllers were generally able to maintain safe separation (although this was in a non-time pressured environment due to the nature of the validation techniques used). Nevertheless, this was to the detriment of the Environmental (Efficiency) KPA as routings were more inefficient. It was agreed that, if traffic loading or complexity increased, the likelihood of the pre-existing hazards occurring would increase.
Initial feedback suggests there will be a trade-off between the improvement in cost efficiency due to more flexible ATCO rostering and the cost efficiency of individual controllers which in turn means an impact on the Capacity KPA. This is reinforced by preliminary modelling which was undertaken in the Performance Assessment Report which showed that if controllers are valid on a larger number of sectors, the controller scheduling can be optimised which can minimise the number of unused hours a controller is neither on position nor on a break.

[1] The participants in the simulations had some reservations in terms of acceptability when high values of latency were simulated (up to 7 seconds in En-Route), especially in combination with a high number of RPAS on the same frequency. With latency values from 0 to 2 seconds, as those simulated in the TMA, neither the controllers nor the remote pilots reported any issue

Controllers identified information needs to overcome the issues highlighted and categorised them into technological, airspace, procedural, regulatory, training or "other". In some cases, multiple information needs were identified to tackle each issue. These information needs will require further refinement and down-selecting as the concept matures.

1.5 Technical Deliverables

Reference	Title	Delivery Date[2]	Dissemination Level[3]
	Description		
D1.1	D1.1 - 10-01a V3 Data Pack	29.10.2019	V3 Public
This **V3 Data Pack** describes the new team organisation (MSP) in high complexity eTMA environment. **OSED/SPR/INTEROP Concept Description** : provides the Safety and Performance Requirements (SPR) and Interoperability Requirements (INTEROP), related to MSP concept. It also includes the Safety Assessment Report (SAR), the Human Performance Assessment Report (HPAR) and the Performance Assessment Report (PAR) that consolidates the results obtained in the V3 validation. **TS/IRS Technical Specification** : provides the requirements specification, covering functional, non-functional and interface requirements related to V3 part of PJ.10-01a(1) **CBA :** provides the Cost Benefit Analysis (CBA) including V3 part of PJ.10-01a(1), expected to support the decision of interested stakeholders (ANSPs) to move towards operational implementation. The maturity phase is V3.			
D1.1b	D1.1 - 10-01a V2 Data Pack	29.10.2019	Partial V2 Public
This **V2 Data Pack** describes the new team organisation (MSP) in high complexity En-Route environment. **OSED/SPR/INTEROP Concept Description** : provides the Safety and Performance Requirements (SPR) and Interoperability Requirements (INTEROP), related to MSP concept. It also includes the Safety Assessment Report (SAR), the Human Performance Assessment Report (HPAR) and the Performance Assessment Report (PAR) that consolidates the results obtained in the V2 validation. **TS/IRS Technical Specification** : provides the requirements specification, covering functional, non-functional and interface requirements related to V2 part of PJ.10-01a(2) **CBA :** provides the Cost Benefit Analysis (CBA) including V2 part of PJ.10-01a(2), expected to support the decision of interested stakeholders (ANSPs) to move towards operational implementation. The maturity phase V2 has not been achieved for the configuration 1PC – nECs in HD/HC environment.			
D2.1	D2.1 - 10-01b V1 Data Pack	14.11.2018	V1 Public
This V1 Data Pack describes the new approach of Flight Centric ATC in low, medium, high and very high complexity environments. As a basic principle of Flight Centric ATC, a controller is no longer in charge of managing the entire traffic within a given sector. Instead, he/she is now responsible for a certain number of aircraft throughout their flight segment within a given airspace whereas other controllers are responsible for a certain number of different aircraft within the same airspace. The new operating method focusses on aspects of allocation of flights to executive controllers and Conflict Management. The maturity phase is V1.			

[2] Delivery data of latest edition
[3] Public or Confidential

D2.2	D2.2 - 10-01b V2 Data Pack	07.10.2019	V2 Public
This V2 Data Pack describes the new approach of Flight Centric ATC in low, medium and high/very high complexity environments. As a basic principle of Flight Centric ATC, a controller is no longer in charge of managing the entire traffic within a given sector. Instead, he/she is now responsible for a certain number of aircraft throughout their flight segment within a given airspace whereas other controllers are responsible for a certain number of different aircraft within the same airspace. The new operating method focusses on aspects of allocation of flights to Controllers and Conflict Management. The maturity phase is V2.			
D3.1	D3.1 - 10-01c V2 Data Pack	02.09.2019	V2 Public
This V2 ongoing Data Pack describes Collaborative Control, which refers to co-ordination by exception rather than co-ordination by procedure and is facilitated by advanced controller tools, supporting reduced need for coordination agreements fewer boundary constraints.			
D4.1	D4.1 - 10-02a V2 Data Pack	28.11.2018	V2 Public
This **V2 Data Pack** describes the enhanced separation services in low to very high complexity, in En-Route & TMA, in Fixed & Free Route environments. It addressed the 10-02a1 scope, though the split was not performed at that time. **OSED/SPR/INTEROP Concept Description** : provides the Safety and Performance Requirements (SPR) and Interoperability Requirements (INTEROP), related to the TCT, MTCD & MONA enhanced services, using existing information known from ground system. It also includes the Safety Assessment Report (SAR), the Human Performance Assessment Report (HPAR and the Performance Assessment Report (PAR) that consolidates the results obtained in the V2 validation. The Security Assessment Report (SeAR) was produced as well, but is not included in the data pack due to security access restrictions. **TS/IRS Technical Specification** : provides the requirements' specification, covering functional, non-functional and interface requirements related to V2 part of 10-02a1 scope. **CBA :** provides the Cost Benefit Analysis (CBA) including V2 part of 10-02a1 scope, expected to support the decision of interested stakeholders (ANSPs, NM and AU) to move towards operational implementation. The maturity phase is V2.			
D4.2	D4.2 - 10-02a V3 Data Pack	14.11.2019	V3 Public
This **V3 Data Pack** describes the enhanced separation services in low to very high complexity, in En-Route & TMA, in Fixed & Free Route environments for 10-02a1. It addressed as well the 10-02a2 V2 scope, after split decision. **OSED/SPR/INTEROP Concept Description** : provides the Safety and Performance Requirements (SPR) and Interoperability Requirements (INTEROP), related to the TCT, MTCD & MONA enhanced services, using existing information known from ground system. In each topic, dedicated sections provides elements related to the TCT, MTCD & MONA enhanced services using existing information known from airborne system (ADS-C/EPP) It also includes the Safety Assessment Report (SAR), the Human Performance Assessment Report (HPAR and the Performance Assessment Report (PAR) that consolidates the results obtained in the V3 validation for 10-02a1. As for all deliverables, dedicated sections addressed the consolidation obtained in the V2 validation for 10-02a2. The Security Assessment Report (SeAR) was produced as well, but is not included in the data pack due to security access restrictions. **TS/IRS Technical Specification** : provides the requirements specification, covering functional, non-functional and interface requirements related to V3 part of 10-02a1 scope and V2 part of 10-02a2 scope.			

CBA : provides the Cost Benefit Analysis (CBA) including V3 part of 10-02a1 scope, expected to support the decision of interested stakeholders (ANSPs, NM and AU) to move towards operational implementation. Dedicated sections addressed the V2 part of 10-02a2 scope. The maturity phase is V3 and V2 (respectively for 10-02a1 & 10-02a2).			
D5.1	D5.1 - 10-02b V1 Data Pack	17.10.2019	V1 Public
This V1 Data Pack describes the research of Tools/functionalities from PJ.10-02a, which will provide an enhanced level of automation.			
D6.1	D6.1 - 10-05 V1 Data Pack	05.11.2018	V1 Public
D6.1 is the V1 Data Pack of Solution 10-05.It includes OSED V1; VALP and VALR of V1 validation exercises; CBA V1 deliverables. The Operational concept defined in the OSED V1, identifies roles and responsibilities among Remote Pilots (RPs), Air Traffic Controllers (ATCOs), and the other airspace users involved in the IFR RPAS integration concept. It also provides the essential requirements of the RPAS Integration (one of PJ10 objectives), defining the procedures and the required enablers. VALP and VALR report the planning and the results of V1 validation exercises analysing the initial feasibility of the concept. CBA V1 introduced a high-level analysis of cost-benefit.			
D6.2	D6.2 - 10-05 V2 Data Pack	14.11.2019	V2 Public
D6.2 is the V2 Data Pack of Solution 10-05.It includes OSED V2; VALP and VALR of V2 validation exercises; CBA V2 and the TS deliverables. The Operational concept was further elaborated in the OSED V2, which identifies roles and responsibilities of the actors involved through the definition of nominal and non-nominal use cases. It also provides the requirements (operational, performance, contingency) of the RPAS Integration defining additional contingency procedures. VALP and VALR report the planning and the results of the 3 V2 validation exercises analysing the feasibility of the concept in relation to delay and the impact on the Human performance. CBA V2 is a high-level analysis of cost-benefit.			
D7.1	D7.1 - 10-06 V1 Data Pack	26.09.2019	V1 Public
This V1 Data Pack describes Generic (Non-Geographic) Controller Validation research, which will enable an Air Traffic Controller to operate independently of traditional geography-based sectors.			

Table 1: Project Deliverables

2 Links to SESAR Programme

2.1 Contribution to the ATM Master Plan

Code	Name	Project contribution	Maturity at project start	Maturity at project end
PJ.10-01a	High Productivity Controller Team Organisation	PJ.10-01a contributed to validate two Operational Improvements (CM-0303 and CM-0304b). Therefore all elements necessary to validate the solution have been addressed, this comprise Operational Concept including Safety, Security Human performance, Performance and CBA activities and also derived Technical and Interface Specifications. Validation Results on the applicability of the concept come from Real Time Simulations	It has to be noted that the MSP concept is already in operation in some TMA. PJ.10-01a studied the extension to eTMA and En-Route.	V3 in high complexity eTMA environment and En-Route (1PC – 2 ECs)
PJ.10-01b	Flight Centric ATC	PJ.10-01b conducted workshops, fast-time simulations and real-time simulations on research platforms and pre-industrial prototypes in V1 and V2 phases.	V0	V2 in low and medium complexity En-Route environment V1 in high and very high complexity En-Route environment
PJ.10-01c	Collaborative Control	PJ.10-01c conducted workshops and real-time simulations on research platforms and pre-industrial prototypes in the V2 phase.	V1	V2 not completed
PJ.10-02a	Improved Performance in the Provision of Separation	PJ.10-02a contributed to validate five Operational Improvements (CM-0206, CM-0208-A, CM-0209*, CM-0210* and CM-0211). * these were split into two, CM-0209a & CM-0210a addressed by PJ10.02a1 with the listed OIs above and CM-0209b & CM-0210b attached together to PJ10.02a2	The solution has been split into two. Both were V2.	V3 for PJ.10-02a1 V2 for PJ.10-02a2 not completed

		All elements necessary to validate the solution have been addressed, this comprise Operational Concept including Safety, Security Human performance, Performance and CBA activities and also derived Technical and Interface Specifications. Validation Results on the applicability of the concept come from Real Time Simulations		
PJ.10-02b	Advanced Separation Management	The majority of the exercises assessed the tools and concepts sufficiently to complete V1 maturity. The exception is the Dependency and Recommendation Tools considered in EXE-001 where there is a recommendation to carry out further iterative development of the concept at V1.	V0	V1
05	IFR RPAS Integration	Activities performed in solution 10.05 gave indications that the integration of RPAS flying IFR in medium complexity En-Route and TMA environment is feasible. Analysis of operating methods and procedure for the integration was performed and an analysis of human performance during normal and contingency situation has been carried out. Latency in the communications was a key aspect to be considered. Clarification on concept of Flight Plan Information; Contingencies and emergencies, and on the technical performances were conducted and requirements were identified. Also Detect and Avoid systems were explored from a technical feasibility.	V1	V2 ongoing
PJ.10-06	Generic (non-geographical Controller Validations)	The joint validation exercise identified the key R&D needs and the key SESAR Solution R&D needs. Research conducted thus far indicated the need for continued development.	V0	V1

Table 2: Project Maturity

2.2 Contribution to Standardisation and regulatory activities

Solution PJ.10-01c: Collaborative Control

The nature of this solution suggests that new regulations may be required to enable the operation of sectors in a "collaborative" manner, as the factors determining responsibility for safety-critical decisions may change due to the introduction of porous airspace boundaries.
ICAO 4444 (16th Edition, 2016) Section 10.1 states requirements for Coordination in respect to the provision of the Air Traffic Control service. The Collaborative Control concept may lead to the inclusion of additional standards and recommendations practices to cover the 'implicit' coordination procedures that the concept requires to be put in place.
The Collaborative Control concept also has an impact on controller licencing (EC IR 2015/340) as it requires ATCOs to have operational knowledge of the shared airspace (collaborative area), which in some cases would imply collaboration between controllers with different ratings.
Dependency with IOP technology (or any other technical means) has also been identified as part of solution development and it should have the corresponding standards and regulations in the future. However cross border collaboration analysis has not been investigated at this stage.

Solution PJ.10-02a: Improved performance in the provision of separation

PJ.10-02a2: For the improvements that take benefits from EPP data, it is critical that EPP standards and/or the use of EPP data by the Ground systems, are mandated in order to rapidly increase the equipage rate. PCP AF6 Implementing regulation NO 716/2014 requires a certain proportion of aircraft to be equipped with ADS-C EPP capability by 2026 and all European ground systems to be ADS-C capable by 2025.

Solution PJ.10-02b: Advanced Separation Management

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Solution PJ.10-05: IFR RPAS Integration

For 10-05 main standardisation activities of reference are

- ICAO RPAS Panel (RPASP) started in 2008 to coordinate and propose references to all other stakeholders acting in view of UAS integration in the civil airspace
- The EASA Regulation (EC) No 216/2008- EC mandates the Agency to regulate Unmanned Aircraft Systems (UAS) and in particular Remotely Piloted Aircraft Systems (RPAS), when used for civil applications and with an operating mass of 150 Kg or more.

The EUROCAE Working Group 105, WG-105 is tasked to develop standards and guidance documents that will allow the safe operation of UAS in all types of airspace, at all times and for all types of operations.

Solution PJ.10-06: Generic' (non-geographical) Controller Validations

Applicable standards and regulations are listed below. Investigation into the impact into these will be explored further at V2.

[1] Reg (EU) 2015-340 (ATCO IR) and applicable Executive Decision (AMC and GM)
[2] Reg (EU) 2017-373 (Common Requirements and Safety Oversight)
[3] ICAO Annex 1 (Personnel Licensing)

[4] ICAO Doc 9868 (PANS TRG)
[5] ICAO Doc 100056 (ATCO Training Manual)
[6] ICAO Annex 11
[7] ICAO PANS ATM
[8] SERA Reg (EU) 2015 923

There may be a need to change some of the regulations, particularly in relation to licensing (Reg (EU) 2015-340). The development of the Generic (Non-geographic) Controller Validation concept will highlight the high level changes that may be required to the current standards and regulations, including the local documentation. Furthermore, the oversight authority will have to be clearly defined for both the issuing of and maintenance of ATCO licences, as well as for the oversight of the services being provided (currently Reg (EU) 2015-340 and Reg.(EU) 2017-373). This activity should take place no earlier than V2 in order to ensure that the changes to the regulations are in line with the feasibility of the solution.

3 Conclusion and Next Steps

3.1 Conclusions

Solution PJ.10-01a: High Productivity Controller Team Organisation

The concept of MSP (1PC – 2ECs) in eTMA and En-Route (medium/high complexity) has reached V3 maturity and is ready for next step.
The concept of MSP in En-Route addressing a team structure with one MSP supporting more than two Executive Controllers needs to be further investigated to prove the full feasibility and operational acceptability and to fully complete the V2 phase. V2 complementary activities are recommended to be performed.
The concept with one MSP supporting two Executive Controllers, tested in the transition scenario has been evaluated to be acceptable without any perceived degradation in the ATC service although with some improvements to be implemented.

Solution PJ.10-01b: Flight Centric ATC

Flight Centric ATC reached V2 maturity for areas that can be covered by a single VHF antenna in wave 1. It is planned to continue work in these environments in wave 2. For areas that cannot be covered by single VHF ground antenna, Flight Centric has not reached V2 in wave 1; a more detailed description of the Wide Area Communication concept including a safety assessment is expected to be delivered in 2020 for this environment to reach V2.

Solution PJ.10-01c: Collaborative Control

Three main points at V2 phase have been analysed. These are:

- The operational feasibility of the concept. This has been demonstrated in very high (TMA) and high complexity (TMA/ En-Route Interface) environments up to an extent (limited only by the scope of the simulations);
- The technical feasibility of the concept. Collaboration in tactical horizon appears to be well supported by the system but the technical feasibility of supporting tools for the application of collaborative control in large areas of airspace needs to be further investigated. However, this is not because of the feasibility of risks computation but because of the uncertainty associated with the trajectory prediction; and,
- Quantification of the performance benefits. Although performance assessment has been carried out, quantitative performance expectations could not be fully demonstrated.

Solution PJ.10-02a: Improved performance in the provision of separation

PJ.10-02a1: Based on the obtained results, it can be concluded that the improved separation management tools/functionalities can work coherently together and are capable of delivering the required benefits. Nevertheless, in order to reach their full potential and to integrate them successfully into the target ATM, detailed analysis of the existing operational settings and accordingly tools' parameters adjustment is required.
PJ.10-02a2: The concept was operationally validated in En-Route environment. The conclusions on the performance, operability, technical feasibility and acceptability of the concept were drawn out based on the results obtained through real-time simulations and indicated readiness of the MTCD enhanced with ADS-C/EPP data to move to V3 maturity phase.

Solution PJ.10-02b: Advanced Separation Management

The majority of the PJ.10-02b exercises assessed the tools and concepts sufficiently to complete V1 maturity. The exception is the Dependency and Recommendation Tools considered in EXE-001 where there is a recommendation to carry out further iterative development of the concept at V1.
The following table presents an overview of the conclusions from each exercise for their respective CD/R tools.

EXE-001	The concept of the Enhanced Tactical Window providing conflict-free clearance options, which also include combined vertical and lateral clearances, has reached V1 maturity. The concept for the Dependency Tool is assessed as easy understandable and plausible. Potential benefits for the controllers might be dependent on the ATM system environment in use. The Dependency Tool and Recommendation Tool require further development at V1.
EXE-002	Information needs were identified for conformance monitoring and alerting in a PBN route network with vertical constraints. The level of automation for CD/R support was also explored to identify the various advantages and disadvantages. It was recognised there is likely a tipping point as complexity and traffic increases when controllers require a higher level of automation support.
EXE-003	The initial indications of the concept of up linking vertical constraints over dynamically generated points to the aircraft were promising. With an intuitive HMI, controllers identified that it can have a benefit to save workload in resolving conflicting situations between aircraft in vertical evolution. With the current timing issues of inserting a constraint in the FMS, which takes about a minute or more on-board, controllers identified that sufficient time should be available to the pilots for the insertion, to avoid a level-off. After the uplink of the constraint, any subsequent monitoring is preferably through system support to the controllers.
EXE-004	The results show that the benefits of the New “What – Next” functionality and New Geo – fencing concept are clear and achievable. The work identified areas for further development and fine tuning of the prototype.
EXE-005	The simulation demonstrated a version of the CD/R tool that would provide a lateral solution to conflicts (with the exception of solutions requiring greater than 30 degree turn and an overtake scenario). Other than in these two scenarios the algorithm performed in the tested environment as anticipated, and similar to what a controller would expect, with solutions that a controller might ordinarily suggest themselves. A series of concept enhancements were identified including using BADA information supplemented with Mode S and ADS-C EPP data, providing vertical solutions and resolving to two lateral solution deficiencies noted above.
EXE-006	This exercise identified the correlation between human factors like uncertainty and motivation with the operational environment of the controller. It considers bringing a balanced approach between deployment of highly advanced systems and human motivational factors. This approach was discussed in workshops with operational experts and benefits of it are identified, which can help in a better task-repartition between human and machine utilizing the best of both the worlds.

In the context of using ADS-C EPP data to support a CD/R tool, key issues include both the availability of a consistent/usable ADS-C EPP report, as well as the accuracy of the predicted climb/descent performance, which can be derived from it. This directly influences the level of confidence that a certain constraint is feasible.

With regards to the performance assessments, initial results show that PJ.10-02b has the potential to positively impact human performance, safety, capacity, cost efficiency, predictability and the environment (fuel efficiency). Due to the nature of the majority of the validation exercises, in the form of workshops, results are based on primarily qualitative evidence. A series of recommendations covering concept and validation have been identified and will be considered going forward in to Wave 2. This Solution will continue to aim at further increasing the quality of service in advanced separation management, by providing a higher level of automation in the decision support tools and further improving the prediction of separation tools. To exploit the potential of higher automation levels and more available information, improvements in controller Human Machine Interface are also foreseen.

Solution PJ.10-05: IFR RPAS Integration

10-05 solution outcomes confirmed that the PJ10 objective of Integration of IFR RPAS can be considered feasible, even though the current level of maturity is not to be considered at V2 completed. Positive conclusion were directly derived by controllers and pilot feedback collected as output of the validation exercises, but improvements from different topics shall be further addressed and investigated.
Improvements and clarification in both the operating methods and technical architecture will be needed in future phases. Contingency and emergency are important concepts to be well clarified. The additional workload which is stressed as usual, and the impact of a new airspace user such an RPAS, has potential consequences on traffic capacity, which shall be quantified. Manned traffic may be impacted from a capacity point of view in those conditions. Impact of delay on communication shall be quantified in terms of acceptable delay and relevant requirements are needed. Impacted enablers shall be consolidated and impact on the architecture shall be improved.

Solution PJ.10-06: Generic' (non-geographical) Controller Validations

Over the course of the validation exercise, eight key issues were identified with the introduction of the concept (with no additional support provided) as listed below.

1. Lack of knowledge of airspace procedures - difficulties in knowing how to plan traffic through the sector;
2. Difficult to plan traffic in an expeditious, efficient and safe manner through the sector;
3. Unnecessary higher workload for an adjacent sector;
4. Difficult to strategically manage conflicts;
5. Difficult to monitor workload in unfamiliar sectors;
6. Do not know the best way to handle traffic and the impact of that traffic in unusual circumstances;
7. Higher workload / task / job demand over time;
8. Feels challenged / pressured to do a good job.

Consequently, controllers identified information needs to overcome these issues which will be later refined and narrowed down as well as prioritised. Although multiple information needs were identified to tackle each issue, it may only be necessary to choose a selection of these. Nevertheless, these do need to be addressed so the concept can progress/mature. Mitigations are likely to be a combination of technological, procedural, airspace and training solutions.

A maturity assessment was conducted and results indicate the concept is on track to achieve V1 maturity at the end of Wave 1.
Further research in Wave 2 will be facilitated by PJ10 WP#73 and will be according to 3 new OI Steps;

- SDM-0203-A: "Increased flexibility in ATCO endorsements within ANSPs (within or cross ATC Center).

- SDM-0203-B: “Increased flexibility in ATCO endorsements across ANSPs”.
- SDM-0203-C: renumber the current "Generic (non-geographical) Controller Validations".

3.2 Plan for next R&D phase (Next steps)

Solution PJ.10-01a: High Productivity Controller Team Organisation

No activity is foreseen for next R&D phase (SESAR2020 Wave 2) for the MSP concept in En-Route.

Solution PJ.10-01b: Flight Centric ATC

Flight Centric ATC will be investigated for low and medium complexity En-Route environment in V3 in wave 2. Main topics in wave 2 will be transitions between sectored and flight centric operations, improved Situational Awareness for the controllers e.g. by improved filtering of traffic information and electronic coordination with other controllers, and many more.

Solution PJ.10-01c: Collaborative Control

Recommendations for the next R&D Phase are:

- To explore if the concept is limited in terms of maximum workable traffic load before needing to revert to standard procedures. This includes how to predict this maximum traffic load and how to manage the switch to conventional operations.
- An increase in the number of measured sectors. One key point is to ensure there is at least one measured sector that is surrounded by collaborative sectors to investigate collaboration across all boundaries.
- Further development of the HMI and Collaborative Support tools including refinement of HMI filtering. Further research on the technical feasibility and development of tools for the planning horizon.
- Further analysis on the feasibility of removing procedural constraints a priori.
- A second iteration of Collaborative Control MOps, with refined procedures to ensure that separation responsibilities are always clear.
- Demonstration / quantification of benefits not yet confirmed (or just estimated) so far. In particular there needs to be a focus on fuel efficiency analysis to ensure reliable results in a future exercise. Also, the capacity KPA should be assessed. One point to consider is the number of measured runs ensuring there are sufficient runs at the higher traffic levels, such that statistical significance can be tested.
- Consideration of non-nominal scenarios in future simulations.
- Integration of Collaborative Control, Generic Validations and Flight-Centric ATC concepts.

Solution PJ.10-02a: Improved performance in the provision of separation

PJ10.02a1: Based on the obtained results, it can be concluded that the improved separation management tools/functionalities can work coherently together and are capable of delivering the required benefits. Nevertheless, in order to reach their full potential and to integrate them successfully into the target ATM, detailed analysis of the existing operational settings and accordingly tools’ parameters adjustment is required.
A set of recommendations has been provided regarding the integration of the tools in the ATM system. They are available in the D4.2.110 – V3 VALR, §5.2.1. They concern especially tools improvements activities and some specific technical topics notably linked to tools’ settings.

Additionally, further enhancements have been provided for future validation activities, to increase the degree of realism of the simulations (e.g. : reduce bias, increase runs, involve AUs) and thus the level of confidence of the results and continue increase the solution maturity level. They are to be found in the D4.2.110 – V3 VALR, §5.2.1.
PJ.10.02a2: The concept was operationally validated in En-Route environment. The conclusions on the performance, operability, technical feasibility and acceptability of the concept were drawn out based on the results obtained through real-time simulations and indicated readiness of the MTCD enhanced with EPP data to move to V3 maturity phase.

A set of recommendations has been provided regarding the integration of the tools in the ATM system. They are available in the D4.2.110 – V3 VALR, §5.2.1. They concern especially tools improvements activities and some specific technical topics notably linked to tools' settings.
Additionally, further enhancements have been provided for future validation activities, to increase the degree of realism of the simulations (e.g. : reduce bias, increase runs, involve AUs) and thus the level of confidence of the results and continue increase the solution maturity level. They are to be found in the D4.2.110 – V3 VALR, §5.2.1.
Finally, as traced in the 10-02a "Opportunities" register on Stellar, it is recommended to address the following subject : "use more precise trajectory prediction provided by ADS-C/EPP for the detection of En-Route wake encounters risks". An action plan should be implemented with Wave 2 solution #53 partners involved in EPP aspects.

Solution PJ.10-02b: Advanced Separation Management

This solution will continue in SESAR W2 in the context of PJ18. It is planned to further research around TP development and Automation.

Solution PJ.10-05: IFR RPAS Integration

10-05 will be continued in SESAR W2 in the context of PJ13. That project will investigate the complete concept of accommodation and integration of IFR RPAS in the A-C controlled airspace complementing the conclusions and the outcomes derived in 10-05. All the recommendation provided from this 10-05 solution should be considered to reach the accommodation (V3) and integration (V2) respective level of maturity.

Solution PJ.10-06: Generic' (non-geographical) Controller Validations

It is currently expected there are two threads of work being conducted in Wave 2, both aiming to prove feasibility of the concept and achieve V2 maturity. These include:

- The "Within ATC Centre" thread focused on the Collaborative Control concept (Solution 73B) as an interdependency has been identified between Collaborative Control and the Generic (non-geographical) Controller Validation concept. The Collaborative Control concept is a toolset to enable a controller to manage traffic not within their airspace without using explicit coordination. This thread will be addressing the first proposed OI step.
- The "Across ATC Centre / ANSP" thread focused on using the Virtual Centres concept (Solution 93) which is applicable when applying the Generic (non-geographical) Controller Validation concept across ATC centres and / or ANSPs. Generic (non-geographical) Controller Validation is an enabler for the Virtual Centres concept.

It is anticipated that the second thread of work will require input from the first thread (e.g. in terms of concept development workshop findings and analytical modelling). The second thread is expected to be more challenging to develop due to the more generic application of the concept.

4 References

Project Deliverables

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[100] PJ10 PROSA, D6.2.070 - EXE-PJ.10-05-V2-004 Platform Availability Note, 27.02.2019.
[101] PJ10 PROSA, D6.2.030 - VALP for V2, 06.03.2019.
[102] PJ10 PROSA, D6.2.005 - Initial SPR-INTEROP/OSED for V2 available, 07.03.2019.
[103] PJ10 PROSA, D6.2.050 - EXE-PJ.10-05-V2-002 Platform Availability Note, 28.03.2019.
[104] PJ10 PROSA, D6.2.015 - Initial TS/IRS for V2 available, 01.04.2019.
[105] PJ10 PROSA, D6.2.075 - Initial VALR for V2 available, 26.06.2019.
[106] PJ10 PROSA, D6.2.080 - VALR for V2, 09.08.2019.
[107] PJ10 PROSA, D6.2.090 - CBA for V2, 13.09.2019.
[108] PJ10 PROSA, D6.2.010 - SPR-INTEROP/OSED for V2, 12.09.2019.
[109] PJ10 PROSA, D6.2.020 - Technical Specification (TS/IRS) for V2, 10.10.2019.
[110] PJ10 PROSA, D6.2.100 - VALP V3 for datapack V2, 13.11.2019.
[111] PJ10 PROSA, D6.2 - 10-05 V2 Data Pack, 14.11.2019.
[112] PJ10 PROSA, D7.1.020 - VALP for V1, 03.07.2018.
[113] PJ10 PROSA, D7.1.030 - VALR for V1, 01.03.2019.
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[123] PJ10 PROSA, D8.8 - Quarterly Progress Report 06, 27.04.2018.
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[126] PJ10 PROSA, D8.11 - Quarterly Progress Report 09, 01.02.2019.
[127] PJ10 PROSA, D8.12 - Quarterly Progress Report 10, 18.04.2019.
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[131] PJ10 PROSA, D9.1 - H - Requirement No. 1, 29.03.2017.
[132] PJ10 PROSA, D9.2 - POPD - Requirement No. 2, 29.03.2017.
[133] PJ10 PROSA, D9.3 - NEC - Requirement No. 3, 29.03.2017.
[134] PJ10 PROSA, D9.4 - M - Requirement No. 4, 29.03.2017.

4.1 Project Communication and Dissemination papers

Solution PJ.10-01a: High Productivity Controller Team Organisation

Solution 10-01a was presented to the ATM community during the tours organised by the SJU at the World ATM congress in March 2018 and March 2019.

Two open days have been organised following the two MSP validation exercises, one in skyguide Zurich ACC on April 4th 2019 and one in ENAV Roma ACC on May 16th 2019.
Articles on MSP concept have been disseminated on skyguide Intranet for the eTMA MSP concept activities and on ENAV Intranet for the En-Route MSP concept activities.

Solution PJ.10-01b: Flight Centric ATC

Solution 10-01b was presented to the ATM community during the tours organised by the SJU at the World ATM congress in March 2018 and March 2019.
Two open days have been organised, one during the FCA validation exercise at HungaroControl premises in Budapest on 16 January 2019 and one after the validation exercise at CRIDA premises in Madrid on 5 April 2019.
An article on FCA has been published in DFS' employees' magazine in December 2017.

Solution PJ.10-01c: Collaborative Control

Solution 10-01c was presented to the ATM community during the tours organised by the SJU at the World ATM congress in March 2018 and March 2019.
Two open days have been facilitated during the two validation exercises at NATS Southampton and ENAIRE Madrid.
Publication to the SJU website have also covered the NATS validation exercise.

Solution PJ.10-02a: Improved performance in the provision of separation

Solution 10-02a was presented to the ATM community during the tours organised by the SJU at the World ATM congress in March 2018 and March 2019.
Each 10-02a validation exercise (V2 and V3) was followed either by an open day in the validation premises, either by an open WebEx presenting detailed results of the exercise.

Solution PJ.10-02b: Advanced Separation Management

Solution 10-02b was presented to the ATM community during the tours organised by the SJU at the World ATM congress in March 2018 and March 2019.

Solution PJ.10-05: IFR RPAS Integration

Solution 10-05 was presented at an Open Day in Leonardo premises in Rome on the 4th April 2019. "SESAR 2020 w1 PJ10-05 IFR RPAS Integration - Open Day"

Solution PJ.10-06: Generic' (non-geographical) Controller Validations

Solution 10-06 was presented to the ATM community during the tours organised by the SJU at the World ATM congress in March 2018 and March 2019.
Publication to the SJU website have also covered joint partner V1 validation exercise.

Social Media; Open-Day´s; Events:

Ref.	Code	Name	Solution	Date	Type of communication
[1]	COM.010	Media Releases on Kick-Off Meeting	PJ.10	15.12.2016	Social Media
[2]	COM.105	Open Day EXE-PJ.10-02a-V2-004 (DFS - NAVIAIR)	PJ.10-02a	16.11.2017	Open Day
[3]	COM.106	Open Day EXE-PJ.10-02a-V2-007 (AIRBUS D&S - BULATSA)	PJ.10-02a	21.11.2017	Open Day
[4]	COM.107	Open Day EXE-PJ.10-02a-V2-001 (DSNA)	PJ.10-02a	15.02.2018	Open Day

[5]	COM.020	WAC Madrid 2018: Guided Tour	PJ.10	06.03.2018	Event
[6]	COM.145	Open Day EXE-PJ.10-05-V1-001 (ECTL)	PJ.10-05	21.03.2018	Open Day
[7]	COM.146	Open Day EXE-PJ.10-05-V1-003 (DSNA)	PJ.10-05	16.04.2018	Open Day
[8]	COM.081	Open Day ENAIRE Exercise	PJ.10-01c	19.10.2018	Open Day
[9]	COM.071	Open Day Budapest V2 EXE 1	PJ.10-01b	16.01.2019	Open Day
[10]	COM.082	Open Day NATS Exercise	PJ.10-01c	31.01.2019	Open Day
[11]	COM.030	WAC Madrid 2019: Guided Tour	PJ.10	12.03.2019	Event
[12]	COM.148	Open Day EXE-PJ.10-05-V2-004 (COOPANS/NATMIG)	PJ.10-05	28.03.2019	Open Day
[13]	COM.114	Open Day EXE-PJ.10-02a-V3 001 DSNA	PJ.10-02a	29.03.2019	Open Day
[14]	COM.115	Open Day EXE-PJ.10-02a-V3 007 (Airbus D&S - BULATSA)	PJ.10-02a	02.04.2019	Open Day
[15]	COM.051	Open Day EXE-PJ.10-01a skyguide (Zurich)	PJ.10-01a	04.04.2019	Open Day
[16]	COM.147	Open Day EXE-PJ.10-05-V2-002 (ENAV)	PJ.10-05	04.04.2019	Open Day
[17]	COM.072	Open Day Madrid ENAIRE	PJ.10-01b	05.04.2019	Open Day
[18]	COM.116	Open Day EXE-PJ.10-02a-V3 005 (ECTL - ANS CR)	PJ.10-02a	12.04.2019	Open Day
[19]	COM.170	FABEC Social Dialogue on Solutions 1a & 6	PJ.10-01a & PJ.10-06	08.05.2019	Social Media
[20]	COM.111	Open Day EXE-PJ.10-02a-003 ENAV	PJ.10-02a	09.05.2019	Open Day
[21]	COM.112	Open Day EXE-PJ.10-02a-002b COOPANS	PJ.10-02a	24.05.2019	Open Day
[22]	COM.113	Open Day EXE-PJ.10-02a-004 skyguideE	PJ.10-02a	29.05.2019	Open Day
[23]	COM.049	Open Day EXE-PJ.10-01a ENAV	PJ.10-01a	04.07.2019	Open Day
[24]	COM.040	Media Releases on project close out	PJ.10	31.12.2019	Social Media

Press Releases:

Ref.	Type	Titel	Solution	Print Date
[1]	Press	Enhanced Tactical Window (ETW)	PJ.10-02b	Feb 2019
[2]	Press	FABEC Social Dialogue	PJ.10-01a & PJ.10-06	May 2019
[3]	Press	Real Time Simulation Exercise on the integration of big drones conducted in Rome	PJ.10-05	Apr 2019
[4]	Press	New Controller Team Organisation	PJ.10-01a	Nov 2018
[5]	Press	Real Time Simulation on Collaborative Control concept	PJ.10-01c	Oct 2018
[6]	Press	Safe RPAS integration simulated in Italian and Maltese airspace	PJ.10-05	Ma 2018
[7]	Press	SESAR tests techniques for managing large drones in commercial airspace	PJ.10-05	Apr 2018
[8]	Press	IFR RPAS Integration DSNA EXE	PJ.10-05	Jan 2018
[9]	Press	Any Controller, Any Airspace	PJ.10-06	Oct 2018
[10]	Press	BULATSA hosted a TESLA Visitors' Day	PJ.10-02a	Nov 2017
[11]	Press	BULATSA conducts a validation under project PJ 10 activities of SESAR Programme	PJ.10-02a	Apr 2019
[12]	Press	Successful SESAR 2020 Flight Centric ATC validation and open day at HungaroControl	PJ.10-01b	Mar 2019

Appendix A Glossary of Terms, Acronyms and Terminology

A.1 Glossary of terms

Term	Definition	Source of the definition

Table 3: Glossary

A.2 Acronyms and Terminology

Term	Definition
ATM	Air Traffic Management
EC	Executive Controller
MSA	Multi Sector Area
MSP	Multi Sector Planner
PC	Planner Controller
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)

Table 4: Acronyms and technology

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