Future architecture of the European airspace

Transition plan

SESAR
JOINT UNDERTAKING

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Executive summary

The Airspace Architecture Study was presented at an event organised by the Sky and Space Intergroup of the European Parliament in March 2019, highlighting that, *'without an acceleration of ATM modernisation and complementary changes, the situation of air traffic delays will continue to deteriorate to an unprecedented level'*. It proposed a progressive transition strategy towards the Single European Airspace System in three 5-year periods, while building on known best practices and quick wins, as well as existing initiatives such as SESAR. The rationale of the study is that by enabling additional airspace capacity, the air traffic management system will be able to cope with the significant growth in air traffic, while maintaining safety, improving flight efficiency and reducing environmental impact.

Conscious of the urgency to act to address the capacity and resilience challenge, this transition plan identifies three key operational and technical Measures that need to be implemented in the very short term (2020 to 2025) in order to set in motion the transformation changes outlined in the Airspace Architecture Study.

These 3 Measures are:

- Launch an airspace re-configuration programme supported by an operational excellence programme to achieve quick wins;
- Realise the planned roll-out related to mature SESAR Solutions supporting the implementation of cross-border free route, and air-ground and ground-ground connectivity;
- Accelerate market uptake of the next generation SESAR technologies and services in order to prepare the de-fragmentation of Europe's skies through virtualisation and the free flow of data among trusted users across borders.

Further to these three Measures which are developed in this document, this transition plan also proposes how the Airspace Architecture Study recommendations can be taken up in existing plans that support the implementation of the Single European Sky. These include the proposed update of the European ATM Master Plan implementation level (Level 3) to ensure that SESAR is fully aligned with the recommendations of the study. An assessment was also done for other key documents surrounding the European ATM Master Plan and supporting its implementation such as the Network Strategy Plan, the Deployment Programme, the European Plan for Aviation Safety and the European Standards Rolling Development Plan[1].

The implementation of these Measures are conditions to address the current capacity challenges with short-term actions as well as to secure the Airspace Architecture Study implementation timeline. They have to be seen together with the planned set-up by 2025 of an enabling framework for ATM Data Service Providers (ADSPs), capacity-on-demand services and rewards for early movers which are not further developed in this plan as they are being progressed directly at European Commission services level at the time of writing this report. The successful and timely set-up of such enabling framework is a key prerequisite to the successful implementation of this transition plan.

Taken together, the proposed three Measures will facilitate putting in motion a successful transition towards a Single European Airspace System that leverages modern technologies. A successful transition will only be possible through strong involvement from Members States, as well as collaboration and commitment from all ATM stakeholders and professional staff. The approach will need to focus on building and maintaining consensus for the transition, including adequate change management and risk management processes.

[1] The Network Strategy Plan is owned by the Network Manager, the Deployment Programme by the SESAR Deployment Manager, the European Plan for Aviation Safety by EASA and the European Standards Rolling Development Plan by the European ATM Standards Coordination Group.

1 Introduction

1.1 Context

The '*proposal for the future architecture of the European airspace*' (the "Airspace Architecture Study', or 'AAS') was developed by the SESAR Joint Undertaking ("SESAR JU") in close coordination with the Network Manager. It re-confirmed that, '*without an acceleration of ATM modernisation and complementary changes, the situation of air traffic delays will continue to deteriorate to an unprecedented level*'[2]. In other terms, status quo is not an option.

Handed over to the European Commission[3] on 5 February 2019, the Airspace Architecture Study was publicly presented on 5 March 2019 at an event organised by the Sky and Space Intergroup of the European Parliament (SSI). Since then the AAS has been made public (https://www.sesarju.eu/node/3253). It contains proposals to address the airspace capacity and resilience challenges, both in the short-term and in the medium to long-term, by combining airspace configuration changes and new technologies to decouple the service provision from the local infrastructure, by enabling cyber-secure data sharing, and by increasing progressively the level of automation support.

The conclusions and recommendations of the AAS have been well received by the aviation community, who expressed broad support in principle. In particular, the AAS recommendations were taken on board by the report of the Wise Persons Group on the future of the Single European Sky[4], which was submitted to the Commission in April 2019. The Group recommended that a Digital European Sky should be implemented based on an agreed roadmap building on the recommendations described in the AAS, and that a new market for ATM data service providers should be created.

In such context, the European Commission has asked in April 2019 the SESAR JU, in close cooperation with the Network Manager and Eurocontrol, to develop '*a transition plan regarding the operational and technical dimensions of the target architecture defined in the airspace architecture study*'.

In view of the worsening of the capacity situation and the fast-growing flight delays affecting the European network, generating unnecessary extra costs to airlines, negative environmental impact and degradation of passenger experience, the Commission services have recently added a strong sense of urgency to move towards the implementation of the AAS and asked to focus on the actions and programmes that aim at bringing the proposed AAS transition strategy into motion, with a focus on short term solutions to the capacity crunch.

[2] Airspace Architecture Study, Executive Summary.

[3] Hereafter "the Commission" or "the EC".

[4] The Wise Persons Group on the future of the Single European Sky was established by the European Commission in 2018 to provide recommendations on the future direction of European air traffic management.

1.2 Objectives and scope

The AAS gives a clear overview of the concepts and changes that will allow building a more optimal and efficient European upper airspace. However, it has not developed a transition plan to move from paper to reality. Additionally, the required involvement and commitment of different stakeholders and the need to gradually evolve towards a cross-border service-oriented approach make indispensable a document that links all aspects and aviation communities.

The Wise Persons' Group recommendation No 4 calls for the implementation of '*a Digital European Sky based on an agreed roadmap building on the recommendations described in the Airspace Architecture Study'*. Because of the need to provide quickly very short term answers to the capacity crunch and the ongoing process of selection of the next Wave of SESAR R&D, the present transition plan is not yet a full implementation plan with associated detailed roadmaps, going all the way up to the complete implementation targeted for 2035 of the targeted "Single European Airspace System", the end goal of the Airspace Architecture Study. For now, it is a plan on how to put the operational and technical dimensions of the AAS "into motion" with a focus on the initial set of actions to be undertaken in the 2020-2025 timeframe and a higher-level view on how to ramp-up the R&D needed for a full delivery of the AAS recommendations.

The Commission services have taken ownership of addressing the regulatory and service business model aspects of the AAS, which is therefore out of the scope of this technical/operational plan. However the team working on this technical/operational plan has stayed in periodical and close contact with this parallel work to allow for a good alignment of all dimensions of the AAS implementation. It should be stressed that the success of the implementation of the present transition plan is subject to the timely and successful conclusion of the work on these regulatory and service business model aspects.

This document thus contains an initial "*transition plan regarding the operational and technical dimensions of the target architecture defined in the airspace architecture study*", with a marked focus on short-term implementation measures with an airspace reconfiguration considering traffic hot spots and exploiting operational excellence for quick wins (Measure 1), as well as existing SESAR implementation commitments that need to be secured, and sometimes accelerated, during RP3 (Measure 2). As it is already foreseen that the capacity relief from these implementation measures will most likely be exceeded by traffic growth over the next couple of years, the plan also contains a description of the measures that will allow full leverage of digital technologies by accelerating SESAR delivery (Measure 3), thus enabling and supporting the timely transition towards the "Single European Airspace System".

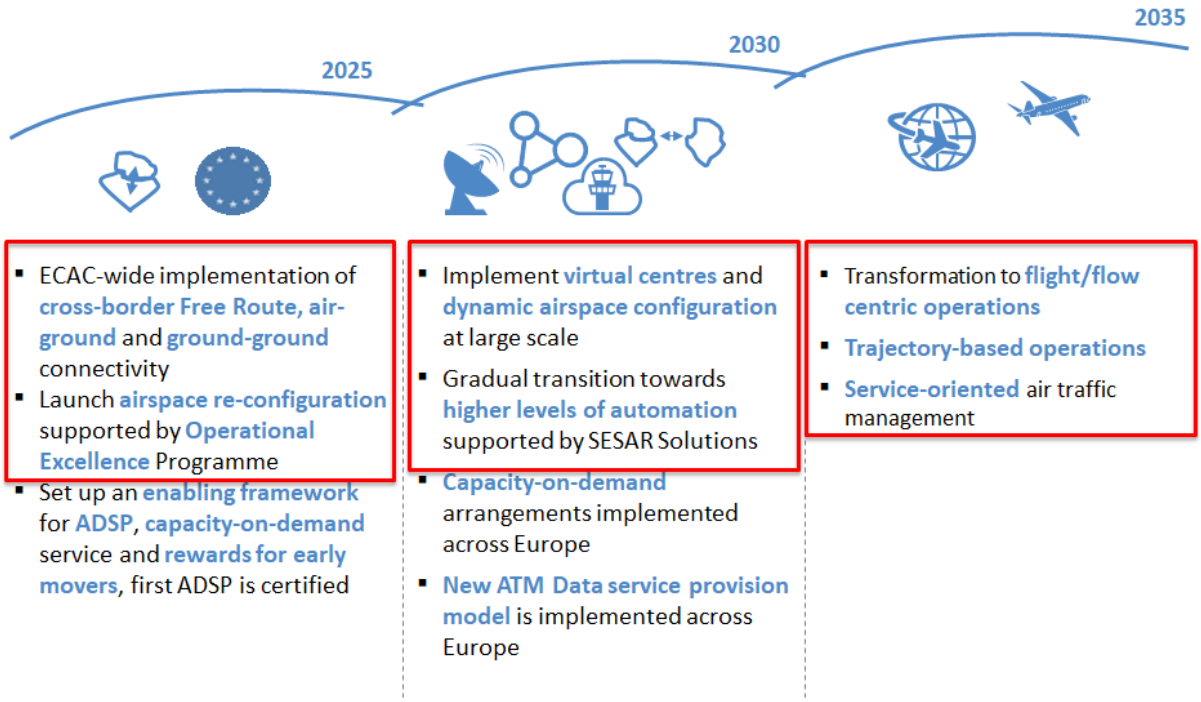


Figure 1: The scope of this operational and technical transition plan in relation to the AAS transition strategy

Three operational and technical Measures are proposed to initiate the transition towards the Target Airspace Architecture. Each of these Measures are further elaborated in the next chapters.

- Measure 1: Launch an airspace re-configuration programme supported by an operational excellence programme to achieve quick wins;
- Measure 2: Realise planned implementation related to mature SESAR solutions supporting the implementation of cross-border free route, air-ground and ground-ground connectivity;
- Measure 3: Accelerate market uptake of the next generation SESAR technologies and services, to prepare the defragmentation of European skies through virtualisation and the free flow of data among trusted users across borders.

The success of this transition plan will only be possible through collaboration and commitment from all ATM stakeholders including professional staff as well as Member States.

2 MEASURE 1: Launch an airspace re-configuration programme supported by an operational excellence programme to achieve quick wins

In 2018, there was an all-time record of 11,011,434 flights in the network, an increase of 3.8% compared to 2017. En-route air traffic flow management (ATFM) delay was 1.73 minutes per flight compared with the EU-wide performance target for the year of 0.5 minutes. It was double the 2017 figure and resulted in a total of 19.1 million minutes of delay. A similar situation is expected for the year 2019. The capacity performance outlook included in the Network Operations Plan 2019-2024

indicated that capacity performance targets are at stake if urgent structural improvements will not be put in place in the short to medium term. Up to 33 ACCs in Europe will not meet the required capacity targets over the RP3 period. As a result, the Network Manager's "7 Measures for 2019" were agreed to address capacity issues in the short and medium term. One of the actions included in these measures addresses structural airspace bottlenecks.

This action covering the Structural airspace bottlenecks indicates that a high number of Air Traffic Control Centres (ACCs) has started to show structural sectorisation problems with a high traffic demand being recorded in elementary sectors. While this was the case for a high number of ACCs in the FABEC area, similar problems started to appear in Central and South Eastern Europe and on the South-West axis. Urgent action is required to start addressing these structural airspace design problems and to avoid their further aggravation in the longer term. To this effect, the Network Manager proposed the creation of three major seamless airspace re-sectorisation projects to be developed on the basis of operational requirements. They were already discussed and agreed in the context of the Network CDM processes and will be executed with the involvement of all the operational stakeholders, with a particular emphasis put on the ANSPs involvement. This was fully aligned with the short term conclusions of the Airspace Architecture Study.

The development and implementation of those major airspace restructuring projects is based on existing mature operational concepts (Free Route Airspace, Advanced Flexible Use of Airspace[5], Cooperative Traffic Management, etc.) and technologies to enable swift development and implementation. Based on the outcome of the Airspace Architecture Study, such airspace restructuring actions, accompanied by an operational excellence project and supported by the implementation of the technological support foreseen in the context of the Pilot Common Project have the potential to address the high challenges of the RP3 performance targets and deliver the required performance by the end of RP3.

High-level description[6]
Launch airspace re-configuration programme by promoting a collaborative process that would involve all relevant stakeholders. This includes an analysis of areas of inefficiencies at network level, validation activities and delivery of an optimised airspace organisation in compliance with agreed airspace design principles, and based on ECAC wide free-route traffic flows. This new initiative would be complemented by an operational excellence programme, which would aim at identifying best-in-class operations and capture quick wins (through changes in operational procedures, operational utilisation of resources, smaller adaptations to systems, etc.) among all stakeholders and effectively support their harmonised implementation to reduce delays.

The goal is to take concrete steps for ensuring the defragmentation of the European airspace and the delivery of the required operational benefits. The two programmes will be executed separately as they

[5] The implementation of the A-FUA concept shall be conducted in accordance of the provision of Commission Regulation (EC) No 2150/2005 of 23 December 2005 laying down common rules for the flexible use of airspace, notably its Article 4, and will require further works of its associated CDM process before implementation.

[6] Extract from the Airspace Architecture Study

involve separate operational and technical expertise, but close coordination between the two will be ensured throughout their development and implementation. The two programmes will be implemented gradually and will take into consideration other major projects under development and implementation. The need to progress towards seamless cross-border operations will also address systems connectivity and interoperability and improvement of operational procedures.

This milestone is supported by several Solutions, enabling the implementation of the ATM functionalities of the Pilot Common Project – PCP[7] (further elaborated by the Deployment Programme and the ATM Master Plan Level 3) that are now in implementation phase such as:

- Automated support for dynamic sectorisation;
- Extended AMAN;
- Enhanced Demand-Capacity Balancing (DCB) tools such as Collaborative NOP (Network Operations Plan), Short-Term ATFM Measures (STAM), traffic complexity and Target Time management;
- Advanced Airspace Management system including the integration of real time airspace data and further enhancement of rolling Air Traffic Flow and Capacity Management (ASM/ATFCM) processes and systems.

2.1 Optimised airspace reconfiguration, addressing the hot spots

In the context of the Network Manager's "7 Measures for 2019", the Network Manager initiated an action "*addressing structural airspace bottlenecks*". This action has been tackled in full alignment with the approach defined in the Airspace Architecture Study. The approach described below has already been agreed through the Network CDM Processes and is in progress in the FABEC area. It will be followed for the other identified hot spots.

It will address, over the period 2020-2025 a structural approach to airspace sectorisation focusing on a number of hotspot interfaces as described, at a high level, in the map below. The 10 hot spots identified here are numbered only for ease of reference, basically from West to East of Europe, without hierarchy or sense of priority. They are already discussed as part of the action included in the Network Manager's 7 Measures for 2019 – "Addressing Airspace Bottlenecks", and based on the current capacity situation in various parts of the network as extensively discussed in the Network CDM process.

[7] Commission implementing Regulation (EU) No 716/2014 of 27 June 2014 on the establishment of the Pilot Common Project supporting the implementation of the European Air Traffic Management Master Plan.

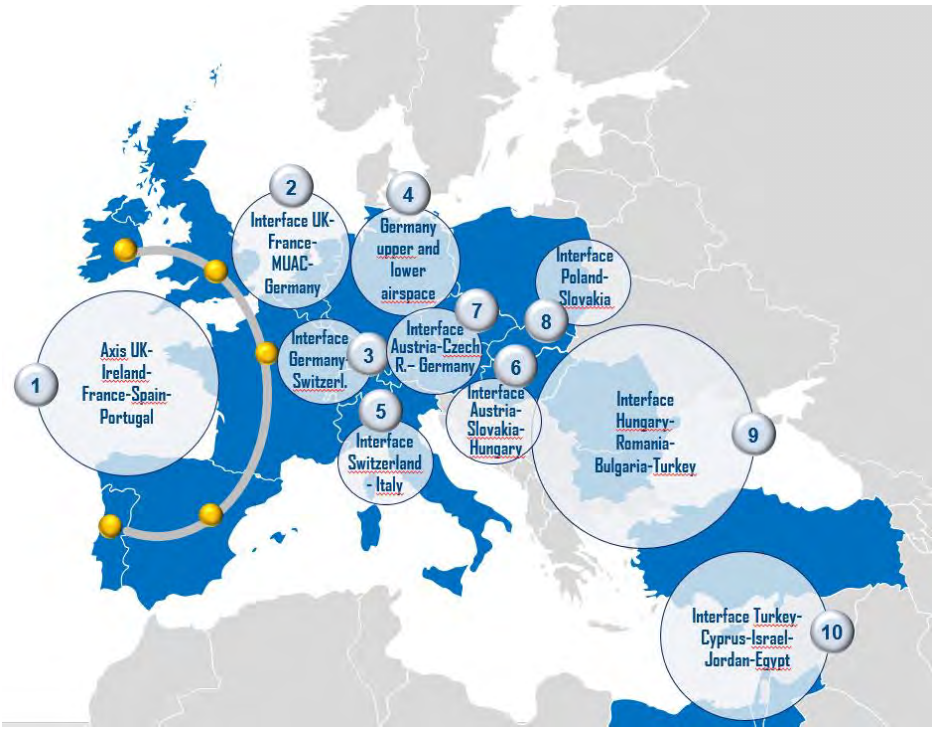


Figure 2: 10 European bottlenecks to address in the short term

The main goal will be the development of an optimised airspace structure, based on cross-border FRA, ATS route network below FRA (if required) with appropriate connexions to the Terminal Manoeuvring Areas (TMAs). In the context of the FRA projects, the connectivity to the TMAs (including TMAs covering several airports) represents an important factor for the appropriate traffic structuring in/out and around TMAs. It will include the definition of an optimum sectorisation, together with the identification of the operational resources needed to deliver the required performance.

The main criteria and assumptions used will be the following:

- Airspace design criteria as defined in the Network Functions implementing Regulation[8];
- High traffic forecast to ensure sustainable development of the airspace sectorisation;
- Capacity and environment/flight efficiency performance;
- For design and operations, European airspace considered as a single airspace;
- Free Route Airspace (FRA) cross-border implementation;
- Addressing lower and upper airspace and connectivity with the TMAs, (including TMAs covering several airports) and Continuous Climb Operations / Continuous Descent Operations (CCO/CDO), re-organisation of airspace above FL410, re-consideration (if necessary and in

[8] Commission implementing Regulation of 24 January 2019 laying down detailed rules for the implementation of air traffic management (ATM) network functions and repealing Commission Regulation (EU) No 677/2011

cooperation with all operational stakeholders), of the airspace classification (on the basis of the ICAO classification), gradual integration of new entrants, etc.

- Including all the evolving civil-military ATM related requirements and other relevant national requirements;
- Aligned with the European Route Network Improvement Plan (ERNIP), Part 1, Technical specification for airspace design methodology and requirements.

Detailed implementation projects over RP3 will be derived and documented in the ERNIP Part 2 and they will ensure convergence towards the target architecture. They will take into account existing airspace projects being in process of development and implementation and will address other developments urgently required. The implementation roadmap will also take into account local and network priorities, major projects and the RP3 performance plans. The process is planned to be finalised by mid-2020. Quick wins projects will be identified and implemented as from 2020/2021. All the project will be run through enhanced Network Manager European Route Network Design (ERND) Function Network CDM processes, involving all operational stakeholders.

Even though this is deemed unlikely, as investments in mature technology required for the Transition Plan is expected to be found in the RP3 Performance Plans, Member States may ask for an adjustment of their costs if they deem it necessary to fully implement the Transition Plan. This is authorised through Article 28.3(a) of the performance and charging Regulation[9] without being detrimental to the approved performance targets.

Initiatives for dynamic sectorisation are already taking place, and their potential for broadening could be subject to large-scale demonstrations under SESAR JU auspices.

The existing technical and legal provisions (including the relevant ICAO Annexes and the EU implementing Regulation on the Network Functions) allow for an expeditious development and implementation process.

The proposed Terms of Reference of the Airspace Reconfiguration Programme, as coordinated by the Network Manager, are included in **Appendix E.1**.

2.2 Operational excellence programme

In parallel with the development and implementation of the new sectorisation projects that will take place in the context of the airspace reconfiguration programme, an operational excellence programme will be put in place with the aim to identify and implement “best-in-class” operations and deliver minimum common operational capabilities among all stakeholders. This will ensure the achievement of operational and technical harmonisation aligning on best-in-class performance and delivering the expected operational performance in line with the Airspace Architecture Study conclusions.

[9] Commission implementing Regulation (EU) 2019/317 of 11 February 2019 laying down a performance and charging scheme in the single European sky and repealing Implementing Regulations (EU) No 390/2013 and (EU) No 391/2013.

The airspace reconfiguration programme and the operational excellence programme will be addressed separately as they involve separate operational and technical expertise, but close coordination between the two will be ensured throughout their development and implementation.

The topics potentially to be covered could include: changes of operational procedures, Letters of Agreement, application of A-FUA[10] and ATFCM, operational utilisation of resources, flight notification and coordination exchanges, harmonised implementation of new operational concepts (Cooperative Traffic Management) and technologies (ICAO FF-ICE, SWIM), smaller adaptations to systems, systems connectivity and interoperability, reasons for different levels of sectors throughput, etc.. The formal and detailed scope of the topics to be covered will be decided jointly and collaboratively by all operational stakeholders.

Detailed implementation projects over RP3 will be derived and documented in the Network Operations Plan and they will ensure convergence towards best-in-class practices. They will take into account existing initiatives being in process of development and implementation and will address other developments urgently required. The implementation roadmap will also take into account local and network priorities and major projects. The process should be finalised by mid-2020. Quick wins projects will be identified and implemented as from 2020/2021. The project will be run through an enhanced Network Manager NOP CDM processes involving all operational stakeholders and will coordinate, as required, with SDM with regard to the deployment activities under its responsibility.

Initiatives for quick implementation of more forward looking concepts will be also identified for implementation or for large scale demonstrations under SESAR JU auspices.

The existing technical and legal provisions (including the relevant ICAO Annexes, the EC implementing Regulation on the Network functions) allow for an expeditious development and implementation process.

The proposed Terms of Reference of the Operational Excellence Programme, as coordinated by the Network Manager, are included in **Appendix E.2**.

3 MEASURE 2: Realise planned implementation related to mature SESAR Solutions supporting the implementation of cross-border free route, air-ground and ground-ground connectivity

Solutions supporting the implementation of the 2025 milestone identified in the AAS Transition Strategy (See Figure 1) have reached their necessary operational and technical maturity and are supported by a common agreement for their implementation, as reflected in particular through existing EU regulations in ATM such as the Pilot Common Project. This Measure therefore reflects those implementation activities that are particularly relevant for the implementation of the AAS by 2025.

[10] A-FUA principles in footnote 5 also apply here.

High-level description
Finalisation of the implementation of cross-border Free Route Airspace, irrespective of national/FIR boundaries, supported by further progress in the implementation of advanced Flexible Use of Airspace will provide the required airspace structures to enable afterwards an efficient and flow-based sectorisation. Air-ground data exchange will be essential to increase progressively the level of automation of the ATM systems. Ground-ground interoperability and data exchange are critical to defragment the technical dimension of ATM operations, and thus to move, at a later stage, to a virtual centre context. Consequently, the implementation of the required airspace structures in the timeframe 2020-2025 supported by the successful and timely deployment of several PCP functionalities, will provide the right framework to address sectorisation and operational excellence.

3.1 ECAC-wide cross-border Free Route Airspace and Advanced FUA

The implementation of the Free Route Airspace and of the Advanced Flexible Use of Airspace already progresses well.

Within the NM geographical area it is realised through the implementation of PCP AF3[11] and relevant Deployment Programme[12] families, as well as relevant ATM Master Plan Level 3 implementation objectives:

- Implementation of Free Route airspace (FRA) including related system improvements;
- A-FUA and ASM systems (ASM tool, real time harmonised ASM data exchanges, rolling ASM/ATFCM process, pre-defined airspace configurations).

In the SESAR Solutions catalogue, FRA is materialised by:

- Solution #33: Free Route through free routing for flights both in cruise and vertically evolving above a specified flight level. This Solution was fully validated by 2015 and was already implemented in a number of ANSPs using FDP (Flight Data Processing) systems adapted to Free Route operations, without neither requiring new tools nor impacting capacity.
- PJ 06-01: Optimised traffic management to enable free routing in high and very high complexity environment. This Solution has addressed the need for new tools in complex environment in support of capacity and increased flight/fuel efficiency. The validation exercises in 2019 have confirmed feasibility of FRA implementation with the existing systems and tools and have underlined the additional benefits thanks to the use of enhanced ATC support tools. Cross border FRA in high complexity environment is already under implementation.

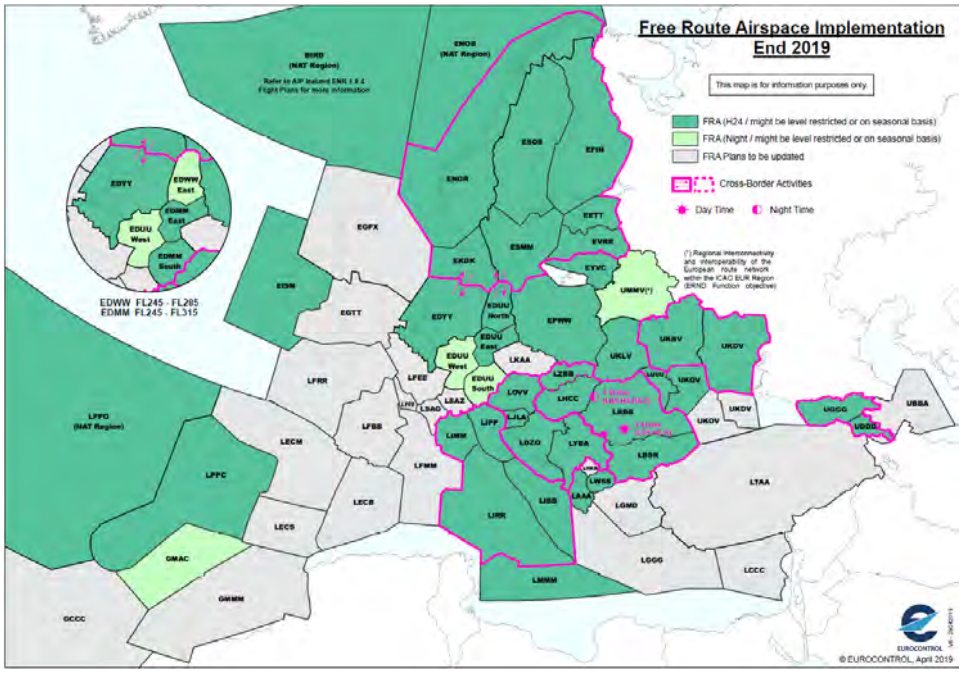
[11] As set out in Commission implementing Regulation (EU) No 716/2014 of 24 June 2014 on the establishment of the Pilot Common Project.

[12] See Article 11 (1) of Regulation (EU) n. 409/2013 on the definition of common projects

In addition, FRA implementation adheres to the concept developed as part of the European Route Network Improvement Plan (ERNIP) and related Technical Specifications for Airspace Design and Airspace Management Procedures. The coordinated implementation is part of the ERND Function of the Network Manager and is based on the airspace design principles included in the NF IR.

The 2019 implementation status of Free Route Airspace and the planned 2024 implementation status of the Free Route Airspace, as currently included in the ERNIP Part 2 – ARN (ATS Route Network) Version 2019-2024 are indicated in the maps below. The detailed planning is included in the ERNIP Part 2 – ARN Version 2019-2024, already approved by the Network Management Board.

The FRA implementation to-date is H24, with very few areas being time-limited and it went to a very large extent down to TMA levels (including TMAs covering several airports) or to the lowest level of the Areas of Responsibility of the concerned air traffic control centres. As the map also indicates, the cross-border implementation has expanded significantly, including in areas with high traffic complexity. In some parts of the airspace where FRA has not been yet implemented, modernisation of local system support is planned to allow for such implementation.



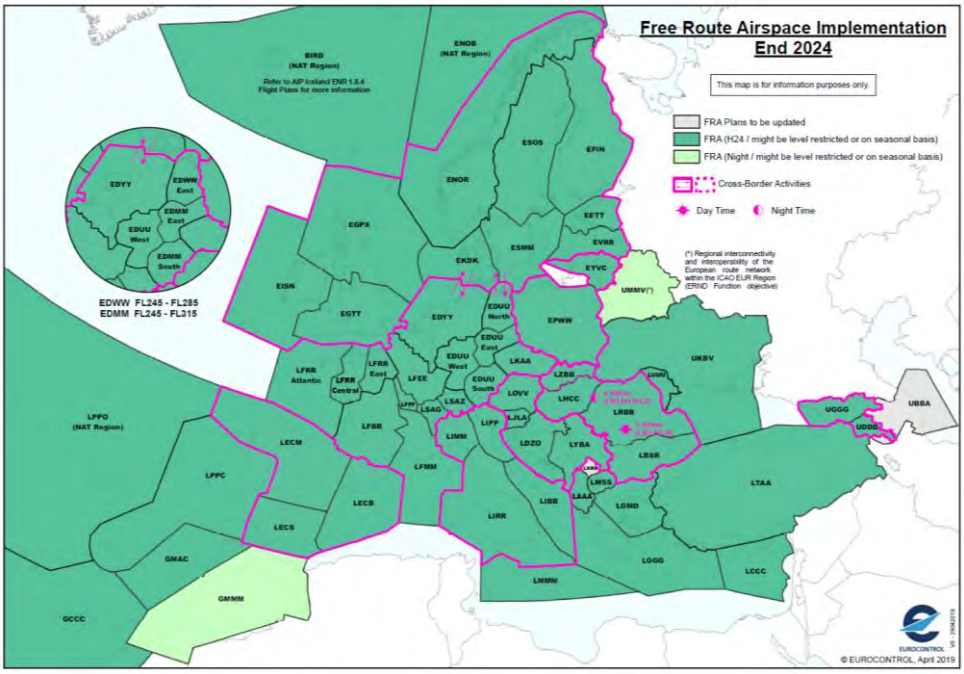


Figure 3: Free Route Airspace implementation status at end 2019 and plans till end 2024

While several cross-border FRA projects have been already implemented or are being implemented (BOREALIS, SECSI, SEENFRA), further efforts will be required over the period 2020-2024/25 to expand the FRA cross-border implementation at pan-European level, to take fully into account the development of airspace structures based on operational requirements and satisfy the needs of major traffic flows. In addition, further adaptation of currently implemented projects will be required to ensure full harmonisation as a major enabler for pan-European cross-border FRA implementation. The implementation of cross-border FRA will also offer better operational options in addressing de-congestion of some critical areas of the European airspace, especially in high density areas. That has been already proven in complex areas where cross-border FRA has been already implemented (e.g. SECSI FRA, Italy).

In parallel, all the evolving military requirements will be integrated into the new airspace structure to reflect the new needs expressed by the military users and to ensure a solid civil/military utilisation of the airspace. This also includes ATC separation responsibilities between General Air Traffic and Operational Air Traffic, ATC coordination complexity and effort, Air Defence Notification, Embargo handling, etc. It will be based on the further progressive implementation of the Advanced Flexible Use of Airspace (A-FUA), based on the enhanced Network CDM processes in cooperation with all stakeholders.

In the SESAR Solutions catalogue, A-FUA is materialised by:

- Solution #31: Advanced Flexible Use of Airspace
- Solution #66: More efficient airspace management.

All the evolutions described above, to be done in the framework of the existing relevant Regulations[13], will be coordinated between the Network Manager within the remit of its functions and all the operational stakeholders through an enhanced Network CDM processes, in cooperation with all operational stakeholders[14] and will be documented in the European Route Network Improvement Plan by mid-2020 with the plan to implement them over the period 2020-2025. The implementation will also continue as part of the PCP implementation coordinated by the SESAR Deployment Manager within the remit of its responsibilities. They will include connectivity to TMAs (including TMAs covering several airports) and CCO/CDO operations, reorganisation of airspace above FL410, review (if necessary and in cooperation with all operational stakeholders) of the existing airspace classification (on the basis of the ICAO classification) in some parts of the airspace, gradual integration of new entrants, etc. Regarding A-FUA, the establishment, improvement and implementation of procedures shall be done in accordance to States prerogatives defined in the related regulatory framework[15]. Furthermore, the utilisation by General Air Traffic of available / released "Special use airspace" (Civil Use of Released Airspace) must be promoted in order to fully reap the benefits of the FUA concept.

The existing technical and legal provisions (including the relevant ICAO Annexes and the EC implementing Regulation (on the network functions) allow for an expeditious development and implementation process.

3.2 Air/Ground and Ground/Ground connectivity through exchange of digital information

Connectivity through exchange of digital information is needed to enable collaborative management of airspace and remote provision of air traffic services. These functionalities are mature and planned to be achieved by the timely implementation of objectives defined by different PCP ATM functionalities as well as pre-SESAR implementations. These objectives are documented in the ATM Master Plan Level 3 and the Deployment Programme and already in the implementation pipeline:

- Air-ground Data link;
- Integration of Extended Projected Profile (EPP) into the ground system;
- New PENS;
- Information Exchanges using the SWIM Blue Profile (ATC data exchanges for coordination and transfer, Trajectory management…);

[13] In particular Commission implementing Regulation (EC) No 2150/2005 of 23 December 2005 laying down common rules for the flexible use of airspace and Commission Implementing Regulations (EU) No 716/2014 on the Pilot Common Project, and No 2019/123 on the network functions.

[14] Which will respect the needs and responsibilities of the military and secure full accountability and buy-in of all operational stakeholders.

[15] In particular Commission Regulation (EC) No 2150/2005.

- OLDI messages currently deployed could be enhanced in a transition phase until full IOP implementation (including the exchanges for extended AMAN and notifications /coordination between Tower, Approach and en-route ATS units);
- Information Exchanges using the SWIM Yellow Profile (aeronautical data, ASM data, extended AMAN data and network related ones) Interactive Rolling NOP data exchanges (occupancy counts and traffic monitoring volumes, AOP/NOP interfaces including API, dynamic sectorisation) ;
- Collaborative flight planning exchanges related to First System Activation message(FSA), ATC Flight Plan Proposal (AFP), Slot Allocation Message(SAM))) between ANSPs and NM and ETFMS Flight Data (EFD) exchanges to support traffic complexity;
- Flight Plan (eFPL) based on Flight & Flow Information for a Collaborative Environment (FF-ICE)
- Legacy and non-standardised TWR/APP/ACC (Tower/Approach/ATC Control Centres) flight data exchanges for notification and coordination purposes
- OAT flight planning.

These functionalities need to ensure the rapid introduction of a secure digital communications backbone that delivers high performance connectivity for enhanced data exchanges between Network Manager, ANSPs, Airspace users and airports. It shall also comprise suitable civil-military interoperability elements.

In the same way as air-ground data link can reduce voice communication, the automated information exchanges between ground units within the same FIR or across boundaries need to be deployed to reduce telephone coordination and release underlying capacity already available in the ATM system.

This transition plan recognises that the IOP solution is critical to enable the European aviation infrastructure to evolve towards higher levels of interoperability, digitalisation and automation. A first set of IOP functionality (“IOP foundation”, including inter-centres mechanisms) has been matured in 2019 leading to a restart of the standard update process (Draft ED-133 A) by the end of 2019. The full functionality of the IOP solution will be delivered at V3 maturity in 2020 allowing the completion of an updated EUROCAE standard (ED-133) in 2021. The revised Flight Object IOP standard will form the basis for industrialisation and implementation projects. To avoid a loose patchwork approach and to ensure alignment of national industrialisation and implementation activities, a specific IOP implementation project could be of value. It could become the first building block for full IOP implementation beyond 2025.

The functionalities listed above have been assessed in the context of the Airspace Architecture Study as having the potential to deliver concrete operational performance benefits. The implementation shall continue as currently planned with a careful and close monitoring to ensure that the appropriate benefits are being delivered on time.

Up to today, data exchange between ATC and the aircraft is based on VDL Mode 2 technology, with performance (latency, bandwidth etc...) that is not sufficient to support the growing need for ATM air ground data exchanges in the longer term. Therefore, development of future communication infrastructure will have to be prioritised to allow achieving the productivity gains and make efficient use of all the other enablers and technologies.

Ground/Ground connectivity is also an enabler of the concept of ATM data service provision, aiming at supporting remote provision of ATS and resilience of the network. This concept supports the

emergence of new business models with several possibilities, from status quo to the emergence of a new category of service providers, which may be implemented subject to the outcome of the parallel study undertaken by the European Commission services and requiring decisions to be taken by regulatory authorities.

4 MEASURE 3: Accelerate market uptake of the next generation SESAR technologies and services

The previous two sections (covering Measures 1 and 2) aimed at describing short-term implementation measures considering traffic hot spots and building on known best practices, quick wins, as well as existing SESAR implementation commitments.

However in the period 2020 to 2025, focusing on short-term implementation measures alone will not enable the timely transition towards the targeted Single European Airspace System that will deliver the ATM performance improvements needed, and fully leveraging modern technologies such as virtualisation techniques and dynamic airspace configurations, supported by the gradual introduction of higher levels of automation support as illustrated in Figure 4.

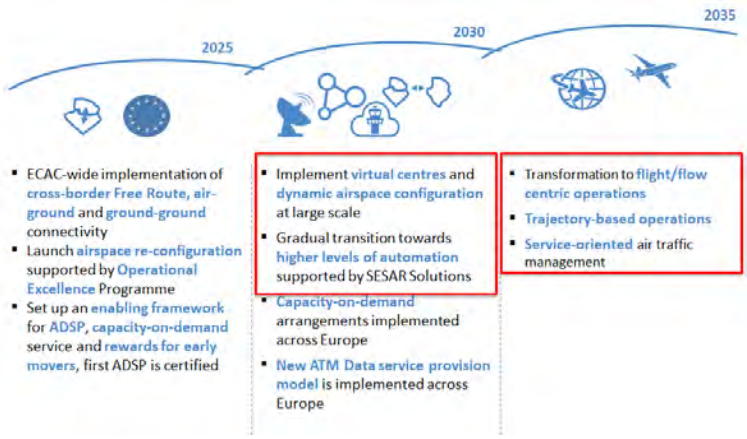


Figure 4: Main technical and operational elements targeted by this Measure (framed in red)

This third Measure is therefore needed to prepare the defragmentation of European skies, through virtualisation and enabling a free flow of data across borders amongst trusted users.

To ensure such timely transition, the remaining R&D should be completed (see further details in **Appendix F**: Link to SESAR Solutions delivery) but also the industrialisation phase of the next generation of SESAR technologies and services should be significantly progressed by 2025, including through standardisation and certification processes involving early movers.

Central to this Measure is the proposed gradual implementation of an EU network of large scale "digital European sky demonstrators" which shall take due consideration of the traffic hot spots outlined previously. This network, tightly connected to standardisation and regulatory activitied to fix the industrialisation gap, will be an acceleration platform for a critical mass of "early movers" representing a minimum of 20% of the targeted operating environments as defined in the European ATM Master Plan, in order to complete pre-implementation activities and maximise the chances of later market

uptake throughout the network, as foreseen in the AAS. Demonstrators will include testing in live environment of concepts, services and technology supporting the achievements of the AAS. This will help build confidence from the supervisory authorities and operational staff by building further performance and safety evidence.

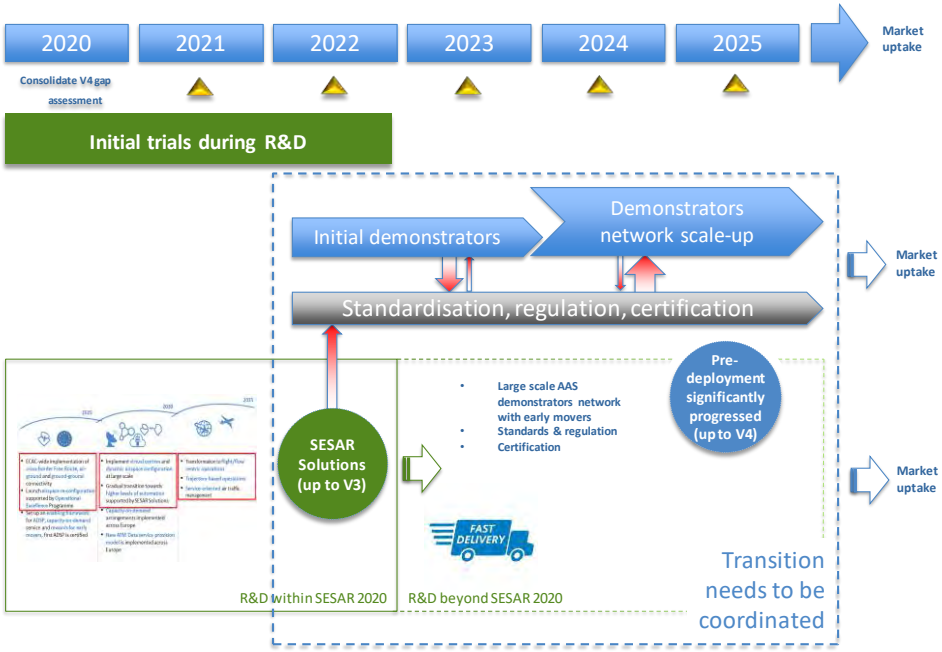


Figure 5: Fixing the industrialisation gap and accelerating market uptake

Once established, this Measure will allow different parts of the system to implement at different speeds depending on local needs whilst maintaining an overall coherence at network level. Figure 5 illustrates this proposed approach, closing the industrialisation gap and simultaneously accelerating market uptake. The next paragraph explains the underlying principles.

4.1 Achieving core AAS R&D

The core R&D that underpins the study is fully covered by the SESAR programme. In accordance with Appendix E of the the Airspace Architecture Study, a gap analysis has been performed to assess the degree of coverage of the scope of the solutions delivered by SESAR R&D against the completed, ongoing, planned and future R&D witin SESAR 2020. The outcome of the analysis is as follows:

Completed R&D	34% of the required SESAR Solutions have been delivered up to the pre-industrial development and integration (V3)
Ongoing and planned R&D	32% of the required SESAR Solutions are expected to be delivered up to pre-industrial development and integration (V3) at the end of SESAR 2020, i.e. by 2022. 23% of the required SESAR Solutions are expected to have completed the feasibility research (V2) at the end of SESAR 2020. They will need further validation towards pre-industrial development and integration (V3) beyond 2022

Future R&D	11% of the required SESAR Solutions have been defined for future research within the existing research programme, targeted to have completed the feasibility research (V2) at the end of SESAR 2020. They will need further validation towards pre-industrial development and integration (V3) beyond 2022

Details of this snapshot[16], including the detailed list of Solutions, their planned maturity date and their link to the AAS milestones, are available in **Appendix F.**

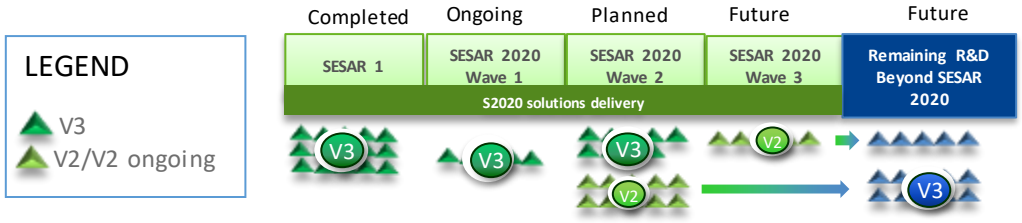


Figure 6: Delivery of SESAR solutions in support of the AAS

It should be noted that the AAS study has been limited in scope to focus on the upper airspace only. It is a consistent subset of the European ATM Master Plan, which is leading and structuring European R&D efforts. Consequently, the AAS architecture remains embedded in a bigger evolution on Air Traffic Management. The overview of the R&D complementary to the AAS is to be found in **Appendix F9.**

4.2 Strenghtening connection between R&D, standards and regulatory work

In parallel to the standardisation and regulatory activities, industrial systems, operational procedures and advanced services need to be prepared for implementation and financial investments need to deliver operational benefits and/or returns. ATM and more generally, aeronautics industry are well participating in the standards development and rulemaking process. Nevertheless, synchronisation and a coherent approach to ensure an efficient convergence to regulations, referenced standards and supporting acceptable means of compliance needs to be ensured to prevent a situation where regulation and standards lag behind technology and industrialisation, creating uncertainty and delays. This so-called industrialisation gap is further explained in **Appendix A.3.**

It is very important to identify the regulatory need for standards on a particular topic as early as possible in the process, remembering that standards not only complement regulations but also provide an important performance reference supporting industrialisation and implementation. In particular a robust standards framework will be essential in supporting the move towards a service-based ATM provision to ensure that performance and safety expectations continue to be met.

The provision of SESAR material as well as the expertise and effort of the SESAR partners is critical in accelerating the standards development timeline. An effective iterative approach between pre-

[16] For solutions in the R&D phase, this snapshot presents the expected maturity date with the best information that is available to the SJU at the time of writing this document.

industrial development and integration (V3) and standards development needs to be found. The involvement of the wider ATM industry and other stakeholders through the standards process is necessary and important as it will not only be the SESAR partners who need to implement these solutions.

Once the need for standards and specifications has been identified and the feasibility research (V2) has been completed, then the planning for the pre-industrial development and integration (V3) activities in SESAR should be accompanied by a plan for standards development, as well as the expected interfaces between the two, i.e. provision of draft and final SESAR material, expert involvement and coordinated planning and decision making.

In that context, the European ATM standards coordination group (EASCG) is a joint coordination and advisory group established in 2015 to coordinate the ATM-related standardisation activities, essentially stemming from the European ATM Master Plan, in support of Single European Sky implementation. It has developed and maintains an overarching European ATM standardisation rolling development plan (RDP), based on the standardisation roadmap from the SESAR framework, inputs on the standardisation plans of its members (including the military), and where needed other key actors in the aviation domain. The EASCG provides a forum to share and discuss standardisation matters between its members to monitor the development of fit-for-purpose standards.

The standards identified so far are often used as means of compliance to the regulatory requirements. What needs to be considered is the need for standards to support product development and procurement which are also important in supporting SESAR R&D results implementation and enabling an accelerated market uptake.

4.3 Accelerating industrialisation and market uptake through a network of “digital European sky demonstrators”

A key to success is the capability to provide a framework and incentives for stakeholders that triggers their appetite to move beyond the pre-industrial development and integration (V3) aiming and targeting implementation (V5) and operation (V6). SJU, Eurocontrol, Standards Development Organisations and EASA/EC should therefore closely cooperate for a seamless and coordinated transition between these stages. This would support the development of a stable and predictable performance-based regulatory framework by EASA/EC, and the development of timely available industry standards. Efficient, effective and lean processes should be used, not compromising in any way the high level of safety and quality the aviation community is expecting. In the frame of this cooperation, the need for developing regulations will be assessed and will follow the regulatory mechanism described above.

To support closing the industrialisation gap, “pioneering” live operations with early movers should be started, aiming at building consensus and gathering further evidence to determine whether regulation (or amendment to existing one) is required. Periodic gap assessments should be performed to trigger specific actions (research, regulation, standardisation or demonstration).

Consequently, central to the proposed measure is the gradual establishment and scale-up of a network of digital European sky demonstrators targeting early movers to accelerate SESAR delivery. The network should become a forum to share knowledge on how to accelerate the transition towards a Single European Airspace System that fully leverages modern technologies. It will focus on so-called “flagships” representing breakthrough technologies, starting with a focus on virtual centres and dynamic airspace configuration as well as solutions boosting automation support which are nearing

maturity. Using industrialised platforms (integrated with operational systems) of the early movers will help to strengthen the evidence for the business case and is expected to increase the buy-in from the community, sparking the interest of stakeholders that were not involved in the earlier R&D. Thanks to this measure, all players including competent regulatory authorities can mutually learn and exchange practical expertise related to the introduction of the next generation of SESAR technologies. Synergies with the newly established airspace re-configuration and operational excellence programmes will also be sought.

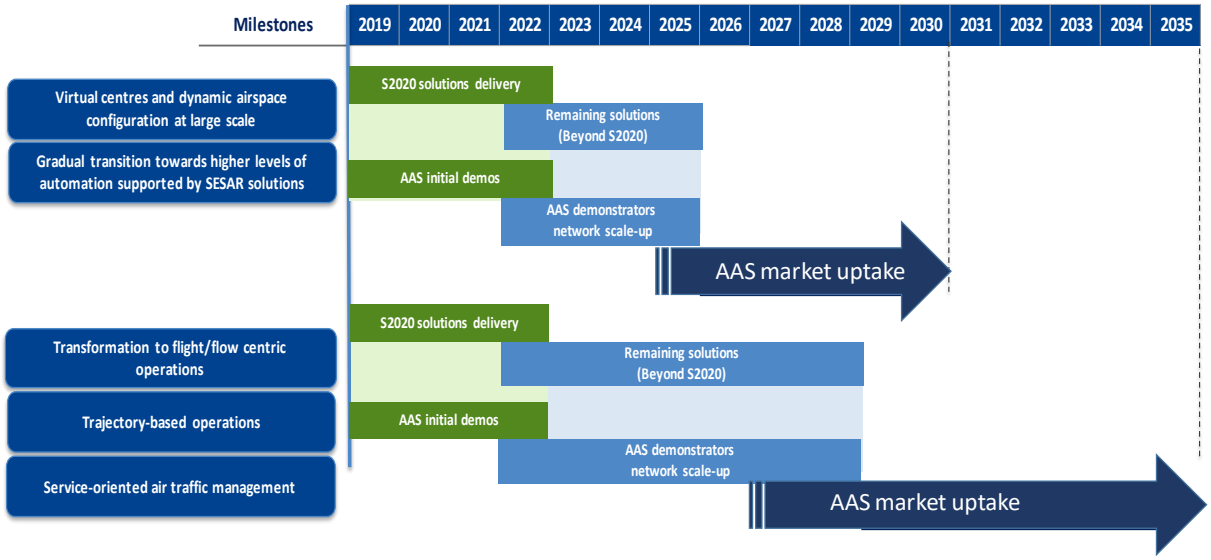


Figure 7: Roadmap: the gradual scale-up of a digital European sky demonstrators network (indicative)

5 Dependencies on actions within and outside the scope of this transition plan

The European-wide harmonised implementation of the AAS architecture requires many actions from many actors. The envisioned end-result can only be achieved if all actions are taken in the right order. Not only the synchronisation between regulatory evolution and technical/operational evolution is key, but also interdependencies between various actions need to be respected within the technical/operational evolution .

The scope of this transition plan is limited to the technical and operational aspects, while in parallel, regulatory aspects will be addressed under direct responsibility of the Commission services. This is illustrated in Figure 8.

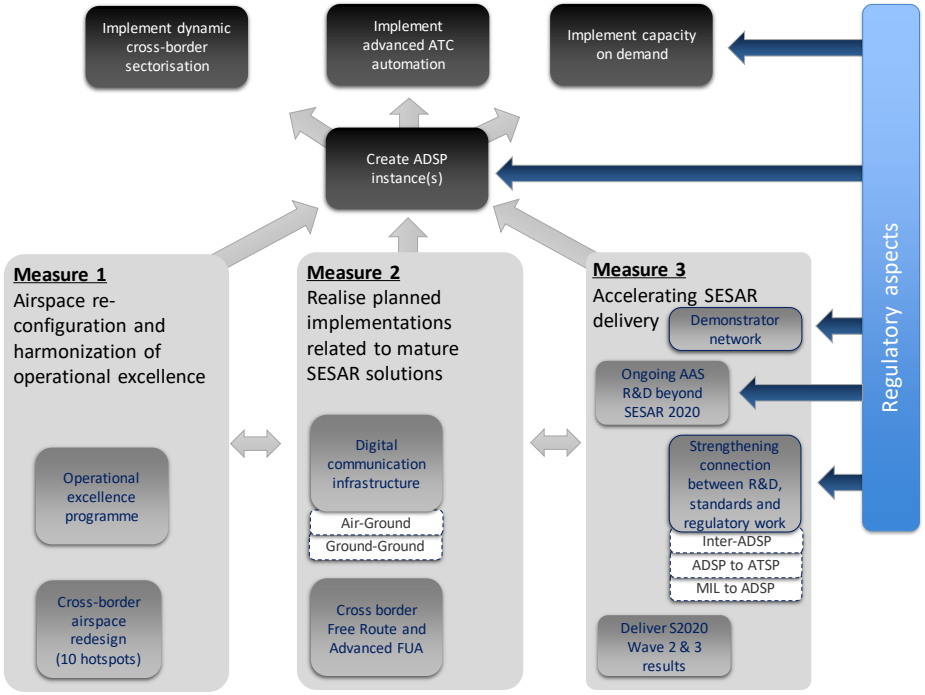


Figure 8 A coherent stepwise transition

Once all Measures are in place, the European wide implementation of fully interoperable ADSPs is enabled. The result is a potentially substantial reduction in the number of instances of Flight Data Processing systems, making the last technical and operational innovation actions much more cost-efficient, when compared to the fragmented situation we have today and facilitating the implementation of:

- Advanced ATC automation
- Dynamic cross-border sectorisation
- Capacity-on-demand

The proposed lines of actions and decisions depicted in the three Measures are depending on a number of prerequisites related to the regulatory framework and service provision aspects, which need to be addressed at European level. The key dependencies are the following:

- Appropriate decision impacting actions beyond the current SESAR 2020 programme should be taken on the implementation of Measure 3 with particular attention to governance and funding arrangements;
- Timely set-up of an enabling framework for ADSPs and capacity-on-demand services, focussing on incentivisation including rewards for early movers, charging and certification.
- Timely set-up of a proper management process (including e.g. the designation of a Project Manager), without which a potential risk could be incurred, resulting in a suboptimal achievement of the Transition Plan.

Details on these dependencies and risk will be found in **Appendix A.6** and **Appendix B** respectively.

Appendix A Roadmaps

A.1 Overall logic

The simplified figure below illustrates the overall logic for new actions to be undertaken to put the implementation of the AAS into motion. It emphasises that in addition to the critical implementation for mature SESAR Solutions and pre-requisites (Measure 2), a strong coupling between airspace design and technologic enablers should be achieved by capturing synergies between the proposed implementation of the new programmes (Measure 1) and the launch of a network of demonstrators to accelerate market uptake (Measure 3).

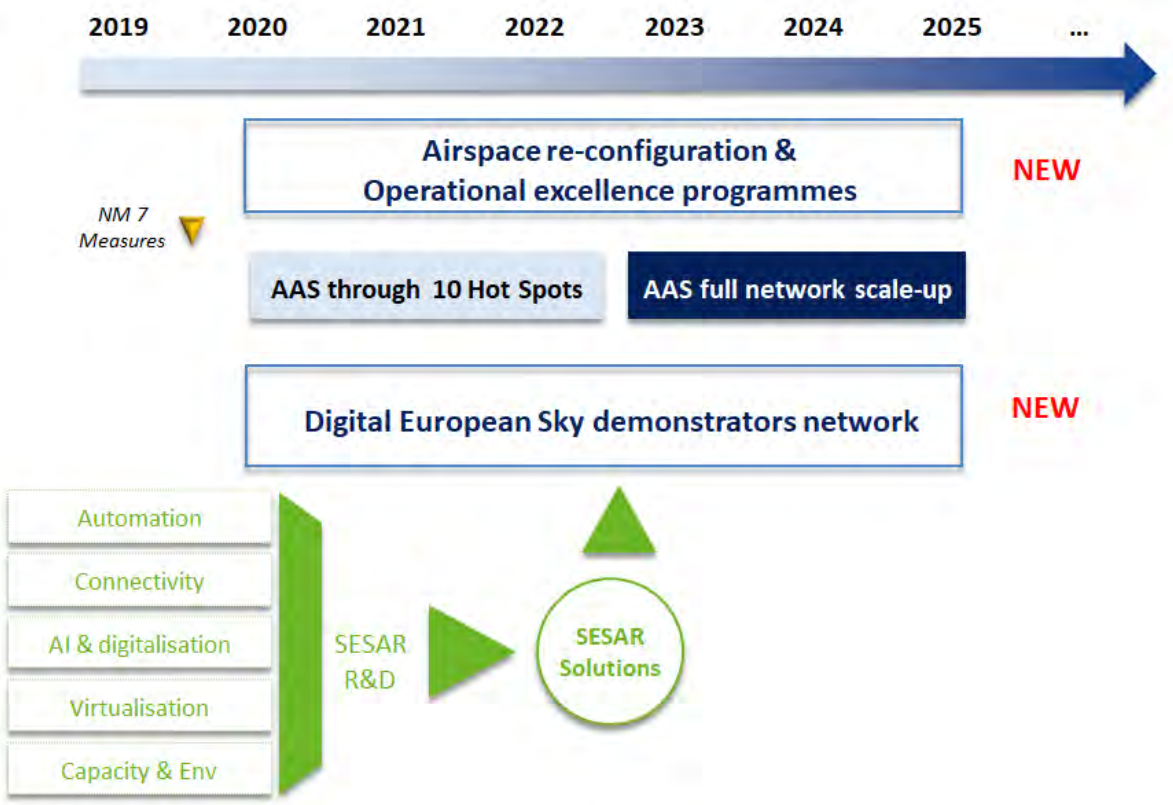


Figure 9: Roadmaps: the overall logic

A.2 Short-term implementation measures addressing hot spots

Measure 1 of this transition plan requires that a number of short-term measures be implemented, first focusing on the identified “hot spots” requiring immediate action, but also having to be implemented throughout the entire ECAC European airspace, the final implementation deadline being 2025. These measures have to be seen together with the planned roll-out of mature SESAR Solutions identified in the European ATM Master Plan in the period 2020-25 (Measure 2, that all have well defined roadmaps and implementation milestones).

When	What	How
2019	NM and operational stakeholders best effort on “7 Measures for 2019”	NM prepares to launch an EU-wide airspace reconfiguration and operational excellence programme with an initial focus on 10 hot spots
2020	NM and operational stakeholders - initial delivery of airspace reconfiguration and operational excellence programme in 10 hot spots	NM to launch and monitor with ANSPs addressing measures related to airspace design and operational excellence
2021	NM and operational stakeholders - 10 hot spots airspace reconfiguration and operational excellence programme - delivery	NM continues and monitors the initiatives with ANSPs addressing measures related to airspace design and operational excellence
2022	NM and operational stakeholders airspace reconfiguration and operational excellence programme at network level - initial delivery	NM continues and monitors the initiatives with ANSPs addressing measures related to airspace design and operational excellence, with enhanced focus on cross-border implementation
2023	NM and operational stakeholders Airspace reconfiguration and operational excellence programme at network level - delivery	NM continues and monitors the initiatives with ANSPs addressing measures related to airspace design and operational excellence, with enhanced focus on cross-border implementation
2024/2025	NM and operational stakeholders airspace reconfiguration and operational excellence programme at network level - delivery NM and operational stakeholders dynamic airspace management with virtualised network platforms initial implementation	Finalisation of the airspace reconfiguration programme and operational excellence projects and NM initiates dynamic airspace management with virtualised platforms

Table 1: Short-term implementation measures roadmap

A.3 The industrialisation gap

Successful development of a system depends on implementing adequate methods to ensure that the planned system is achievable and will be fit for purpose.

The European Operational Concept Validation Methodology (E-OCVM) is applied in the European ATM R&D collaborative projects. It provides a common reference for the assessment of concept maturity and the management of concept development transitions from R&D over industrialisation to implementation. Figure 10 below provides an overview of the whole lifecycle of ATM concepts.

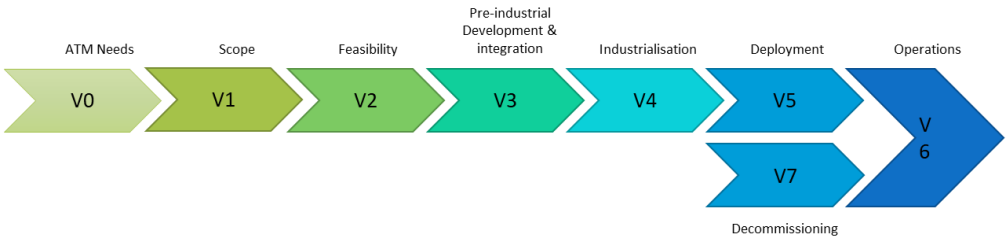


Figure 10: The E-OCVM life cycle

Currently SESAR Solutions are handed-over to the industry at a V3 maturity level. The hand-over material, used to make decisions concerning transition to implementation, is essentially composed of a set of operational and technical requirements including their validation results, covering for example performance assessments.

At this stage of maturity, validations are performed by a representative but limited group of stakeholders in an environment that is as close as possible to real operational environments: simulations and shadow mode operations, relying on pre-industrial prototypes.

V4 is an essential phase in the SESAR innovation cycle which lies between the end of research and the start of larger scale implementation.

One of the most critical aspects of the V4 phase is the development of mature and robust standards which will support both the industrialisation of the systems, procedures or services in question, and provide the basis for means of compliance for any neccessary regulations.

Aviation standardisation has a history of delivering high quality material through a consensus based process, however in some cases this can take some time to complete. The increased pace of technological change and the need to deliver timely solutions to solve ATM performance issues is to streamline the processes and procedures as well as the handover between different stages as described above.

What complicates the V-4 phase is that parallel to the standardisation and regulatory activities, industrial systems and operational procedures need to be prepared for implementation and financial investments need to deliver operational benefits and/or returns. Normally industry is well participating in the standards development and rulemaking process. Nevertheless, synchronisation and a coherent approach to ensure an efficient convergence to regulations, referenced standards and supporting acceptable means of compliance needs to be ensured to prevent a situation where regulation and standards lag behind industrialisation.

Nevertheless, one needs to recognise that each specific implementation project may follow specific implementation strategies: some may not (yet) be subject to detailed implementation regulations; standardisation may follow limited implementations or become essential depending on the scale of implementation. Beyond regulations, standards, procedures or reference material, industrial and operational stakeholders will need to perform their specific business assessment prior to the implementation of products and services. The variability between stakeholder business cases and any associated risks will also entail challenges for industrialisation.

Example

Once SESAR R&D allows to deliver solutions at maturity level V3, airborne industry has to engage a decision for industrialisation (V4). At this stage, airspace users do not commit to buy the airborne Solution, and this launch decision for system development is taken by the airframers and their suppliers on their own based on a business case built with the best understanding of market penetration and operational benefits for airspace users.

More specifically, some SESAR Solutions that require heavy infrastructure synchronisation and that have gained the "R&D" maturity may face the challenge of a lack of early adopters as well as a lack of synchronization of investments across national boundaries. At the core of the issue resides the lack of pan-European leadership on investment decision-making that remains taken at national level.

The absence of a structured approach to close this maturity gap represents a high risk to the implementation of the AAS. It is therefore essential that organisations in charge on European ATM evolutions work closely together and secure this V4 industrialisation phase to enable a seamless transition between R&D and Implementation.

A.4 Accelerating SESAR market uptake

The short-term measures described above are necessary to, first, bring an effective answer to the current capacity shortage, but also to "gain time" to allow R&D and pre-implementation activities to be intensified and accelerated as much as possible to bring longer-term and structural solutions that will effectively deliver, by the 2030 and 2035 target milestones, the recommendations of the Airspace Architecture Study and the targeted "Single European Airspace System". This intensification of R&D and acceleration of SESAR market uptake, is synthesised in the figure below.

	When	What	How	
	2020	• Initial demos are launched, focusing at highest maturity SESAR Solutions and considering hotspots • Consolidation of V4 gap assessment	SESAR 2020	First Digital European sky demonstrators
Enhanced coordination of the industrialisation processes to advance solutions more rapidly through standardisation and certification	**2021**	• Run initial demos	SESAR 2020	
	2022	• Consolidated delivery of SESAR 2020 Solutions related to AAS • Consolidated results of the initial demos launched • Launch EU network of Digital European Sky demonstrators	SESAR 2020 SESAR 2020 TBC	
	2023	• Run EU network of Digital European Sky demonstrators	TBC	
	2024	• Run EU network of Digital European Sky demonstrators	TBC	
	2025	• Consolidation of results	TBC	

Table 2: Roadmap for accelerating SESAR delivery

A.5 Success criteria for this transition plan

- Clear, stakeholder-wide, including States, ownership and commitment for the proposed transition Measures outlined in this report. As such it is vital to identify the likely impact on stakeholders from the start of executing the transition plan, especially for the military community, where the level of support to the plan's execution will highly depend on such impact.
- The target architecture and conclusions of the AAS are fully respected.
- Transition Measures are prioritised with an explicit focus to put the "AAS into motion" in the short term (2020 – 2025) to address the current and growing capacity issue, in particular in relation to identified "hot spots". Measures that are already ongoing are duly reflected and additional measures that are deemed necessary are highlighted.
- It is assumed that enabling regulatory frameworks for Air Traffic Management Data Service Provision (ADSP), capacity-on-demand service and rewards for early movers, which are part of the recommendations of the Airspace Architecture Study, are all fully implemented in 2025.

A.6 Transition logic and dependency between the Measures

This transition logic brings together various considerations related to e.g. technical and operational dependencies between changes, business cases, time to deployable maturity, transformation risks, etc. Even if the exact transition schedule may evolve over time, it is expected that this transition logic will remain valid in most cases.

Figure 8 has been refined into Figure 11 to indicate all the interdependencies[17] between the actions. Each interdependency is visualised trough lines between the actions that are explained below. A provisional outcome of the regulatory aspects is included to clarify the interdependencies between the operational/technical aspects and the regulatory aspects.

[17] Rectangles represent actions. Lines represent interdependencies. Sequential relations are visualised by an arrow, while bi-directional arrows visualise parallel coordinated actions.

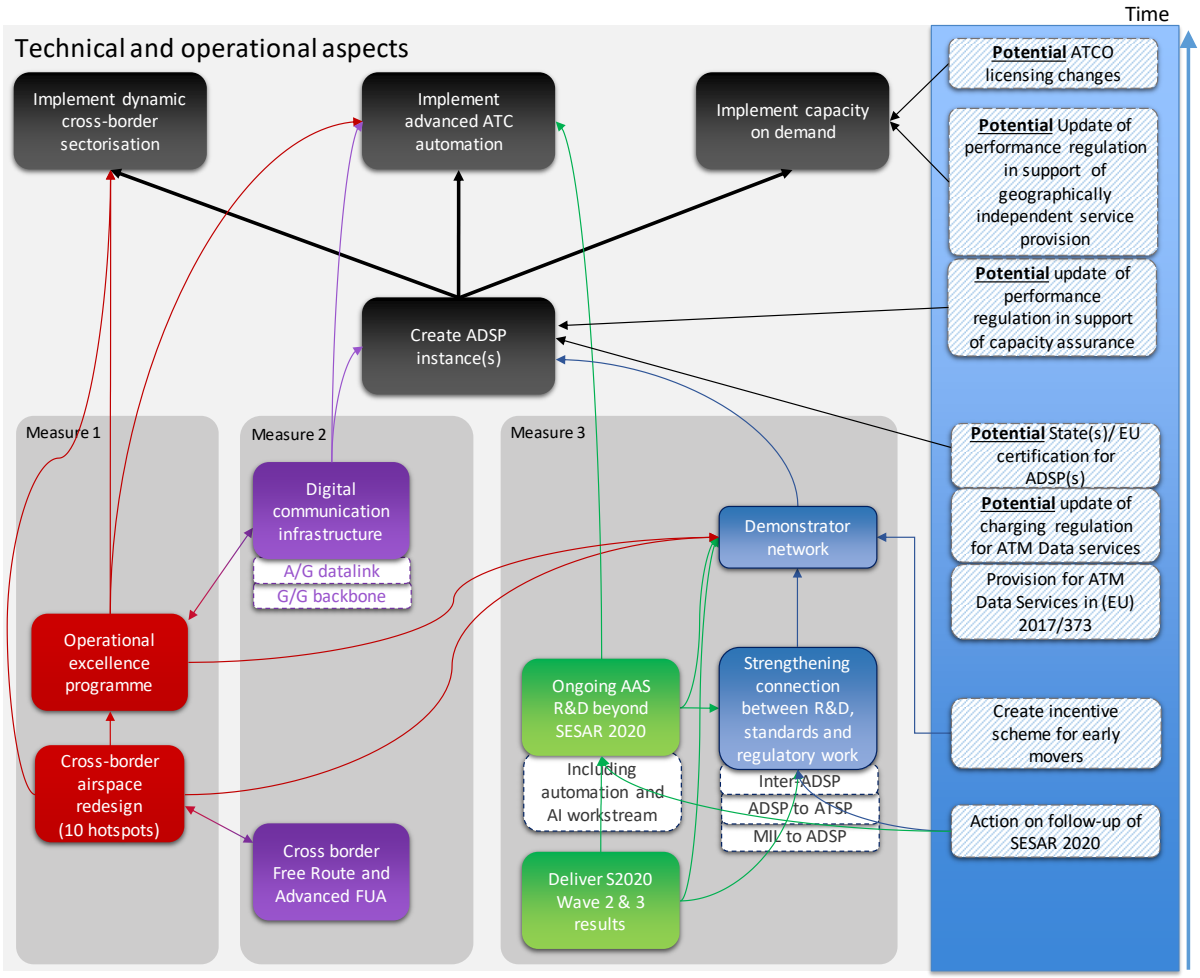


Figure 11 Detailed interdependencies

Measure 1 consists of "cross-border airspace redesign" and the "operational excellence programme". The following interdependencies exist:

- The creation of a seamless cross-FIR FRA for the whole ECAC region will allow airspace users to fly their preferred route across the entire ECAC airspace without intermediate entry and/or exit point at FIR boundaries. This changes the operational requirements (traffic patterns, bottlenecks and hotspots) that drive airspace design. Starting with already existing structural sectorisation problems, it is necessary to synchronize the Free Route and advanced FUA implementation and the redesign of sectors in support of these evolving operational requirements.

- Early demonstrators of cross-border dynamic sectorisation through the creation of a network of digital Europan Sky demonstrators can only be done once the involved ANSPs have redesigned their airspace defining cross-border dynamic sectors, as part of the bigger programme on cross-border airspace redesign.

- Early demonstrators of ADSPs through the creation of a network of digital Europan Sky demonstrators only brings the targeted resilience if those centres jointly and collaboratively building one Virtual Centre, have all harmonized their operational procedures and systems through the operational excellence programme to allow for flexible delegation of airspace.

- A full ECAC wide implementation of dynamic cross-border sectorisation and advanced ATC automation, can only be done once all ATSPs within the ECAC area have harmonized their operational procedures through completion of the operational excellence programme. The reason being that full flexibility on allocation of traffic to any ATSP requires not only technical interoperability across all ADSPs, but also requires harmonized operational procedures and principles of all ATSPs.

Measure 2 consists of two actions, the ECAC-wide "Cross-border Free Route and advanced FUA" and the "Digital Communications infrastructure". On top of the interdependencies between Measure 1 and Measure 2, the following additional interdependencies exist:

- The digital communications backbone consists of both Air/Ground and Ground/Ground connectivity. This connectivity is needed to exchange digital information in support of collaborative management of airspace and remote provision of air traffic services. The operational excellence programme that aims to identify and implement best in class operations, requires synchronisation with the implementation of the digital communications infrastructure, as many of the solutions to be harmonized as part of the operational excellence programme, require enhanced data exchange through the improved A/G datalink and the G/G digital backbone.

- The future technology for A/G datalink is essential in enabling the transition to advanced ATC automation with a tighter integration of Air and Ground systems, beyond the current CPDLC capabilities.

- The creation of an ADSP instance to support multiple ATSPs can only be done if a highly reliable and secured Ground/Ground digital backbone, exists between the ADSP and the various ATSPs consuming that service.

Measure 3 is about delivering SESAR R&D solutions, and closing the V4 gap and accelerating SESAR market uptake . It consists of "Delivering SESAR 2020 solutions", "Ongoing AAS R&D beyond S2020", "Strengthening connection between R&D, standards and regulatory work" and "Using early demonstrators to accelerate the V-4 phase". On top of interdependencies already mentioned, the following interdependencies exist:

- Some AAS related solutions under research and development in SESAR 2020 will only reach V2. Further validation is required to fully validate these solutions. This will require some AAS solutions to be further validated beyond S2020.

- Using early demonstrator to accelerate the V-4 phase can only done after the R&D that is relevant for the AAS, has delivered solutions that have reached V3 maturity, and their corresponding solution packs are publicly available. A distinction in timing for launching demonstration projects has to be made, for demonstration solutions that have reached V3 maturity in S2020, and those that will reach V3 maturity beyond S2020. Such demonstrations will be a useful vehicle to secure the specific inter-ADSP interoperability standard for synchronising trajectory information and an interface standard between ADSPs and ATSPs, allowing ATSPs to interact with the trajectories. As indicated in the figure, inputs will be required on the interface standard(s) between ADSPs and military stakeholders.

- Standardisation activities on specific solutions cannot start before the R&D that is relevant for the AAS have delivered those solutions at a miminum of V2 maturity, with the V2 solution

packs publicly available. A distinction in timing for standardisation has to be made, for standardizing solutions from S2020, and those delivered beyond S2020.

- The continued Automation and AI workstream on R&D beyond S2020 will deliver future solutions contributing to advanced ATC automation.
- The standardisation process will require adjustments to enable acceleration of the V4 phase. A strengthening of the connection between standardisation activities on the one hand and R&D, demonstration activities and industrialisation on the other hand is needed.
- In this context, a network around “pioneer” implementation projects is created in such a way that it ensures an effective contribution to the accelation of (European) standardisation and regulation.
- It is only after the **standards and regulations** have become available, that a full and ECAC-wide roll-out of **ADSPs** will lead to ECAC wide interoperability, irrespective of the brand of the industrial platform that serves the ADSPs and the ATSPs.

Once the ADSP instances have been created, the last remaining actions will become much easier, in particular because the amount of ADSPs will be less than the number of Flight Data Processing systems that would need to be upgrade when applying the last remaining actions to the current fragmented systems landscape.

- Taylored dynamic cross-border sectorisation will have begun long before an ECAC-wide ADSPs implementation has been completed. However, once **ADSPs** running on the same standards and harmonized procedures have been created everywhere in the ECAC area, **dynamic cross-border sectorisation** will gradually be more flexibly applied as it will be become easier to connect across between any two pairs of ATSPs.
- Due to the substantial reduction in the number of instances of Flight Data Processing systems (now corresponding to the number of **ADSPs**, not to the number of ATSPs), the introduction of **advanced ATC automation** will be substantially more cost-effective, when compared to the fragmented situation we have today.
- With fully interoperable **ADSPs** in place, and harmonized ATSPs all based on operational excellence in place, the last step is the introduction of **capacity on demand**, by flexibly allocating ATSPs (or controllers) to where they are required due to traffic demand, irrespective of the controller’s physical location in Europe.

The proposed lines of actions and decisions depicted in the three Measures are depending on a number of prerequistes related to the regulatory framework and service provision aspects, which need to be addressed and enabled before the operational or technical evolutions can take place. Capacity-on-demand should be implemented across Europe by 2030. These interdependencies should therefore be addressed and sorted out by 2025, to allow early movers to initiate this evolution and support network-wide implementation by 2030

- Whilst the vertically integrated model could continue operating, this is not the recommended option and the evolution towards the acquisition by ATSPs of ATM data from one or more data service providers, which could be developed in accordance with various options and business models, should be enabled, through Commission services confirmation of the appropriateness of the existing regulatory framework or completion of the necessary regulatory evolution. In

accordance with Figure 27 of the AAS, these interdependencies should be addressed and sorted out by 2025.

- The creation of **ADSPs** to serve any ATSP within Europe is expected to require **certification** of the ADSP. To what extend this is really needed is currently being researched under the responsibility of the European Commission services.

- Potentially an appropriate cost and pricing mechanism needs to be defined to be harmoniously integrated within the existing charging scheme, avoiding double charging of the same costs.

- The creation of **ADSPs** to serve any ATSP witin Europe may potentially require an update of the performance regulation in support of capacity assurance. The idea being that ANSPs should provide capacity in accordance with an agreed European plan, and their cost efficiency should consider the fixed costs linked to the capacity they offer, regardless of whether it was used or not. To what extend this is really needed is currently being researched under the responsibility of the European Commission services.

- The introduction of **capacity on demand**, by flexibly allocating ATSPs (or controllers) to where they are required, may potentially require an update of the performance regulation in support of geographically independent service provision. The current calculation of unit costs is country based, which is not compatible with the notion of capacity on demand. To what extend this is really needed is currently being researched under the responsibility of the European Commission services.

- The introduction of **capacity on demand**, by flexibly allocating ATSPs (or controllers) to where they are required, may require further **changes on ATCO licensing**. To what extend this is really needed is currently being researched under the responsibility of the European Commission services.

- Appropriate decision impacting actions beyond the current SESAR 2020 programme should be taken on the implementation of Measure 3 with particular attention to governance and funding arrangements.

- An **incentive scheme for early movers** is needed to initiate pioneer implementation of AAS related solutions, particularly those that relate to the split of the ADSP and the ATSP. The resulting network does not only provide a critical mass, but also supports by providing feedback to ongoing R&D and standardisation activities.

Appendix B Risk management

Implementing the recommendations of the AAS requires a concerted effort from all stakeholders. This approach will need to focus on building and maintaining consensus for the transition, including adequate change management and risk management process and buy-in from all stakeholder groups including professional staff.

In relation to the 3 top risks identified in the context of the AAS, this transition plan addresses the following two top risks which have direct operational and technical implications:

- Lack of commitment and/or buy-in resulting in delays or inefficient implementation
- Slow technology uptake hampers the virtual defragmentation of the European skies

While the delivery of this transition plan is already mitigating the risk related to lack of commitment for implementation some initial considerations regarding the above mentioned top risks have been identified in relation to the execution of this transition plan. They are presented below:

Risk description	Impact/Consequence	Mitigation actions
The inability of AAS-TP changes to fit into current/already set up framework and governance may endanger the implementation of the short term measures as presented in the AAS	Within the short term implementation measures (Measures 1 and 2), changes foreseen will have to fit with already scheduled activities, including performance plans for RP3 and key programming documents in particular from Network Manager, SDM, EASA and EASCG.	• The AAS Transition Plan includes an analysis of its impact on the main programming documents from EASA (European Plan for Aviation Safety), Network Manager (Network Strategy Plan, NOP, NDOP, ERNIP, AOP, NM 7 Measures for 2019, the measures agreed as part of the NOP and that should be part of the RP3 response, etc.), SESAR Deployment Manager (Deployment Programme). These entities will ensure alignment of their key programming documents with the AAS Transition Plan. • The AAS-TP short-term measures aim at facilitating completion of the capacity targets contained in RP3 performance plans. They are based on implementations that are already in the pipeline and thus should not affect negatively the preparation of the Performance Plans (either at national or FAB level).

Risk description	Impact/Consequence	Mitigation actions
		In any case, if needed Member States may ask for some adaptations to their adopted RP3 performances plans, or at least adjust their cost-base as authorised by Article 28.3(a) of the performance and charging Regulation.
Unsynchronised work in identifying the changes required for regulatory and institutional framework may delay the implementation of the AAS-TP	This AAS –TP focuses on operational and technical aspects combining technology coming from SESAR programme and changes related to airspace organisation. Meanwhile, the effective implementation of these proposed Measures may require changes in regulatory framework, which must be clearly identified and implemented on time.	• Ensure parallel and coordinated work on the identification of regulatory and institutional needs for successful AAS implementation • Take necessary measures to secure the timely delivery of the appropriate framework in support of the AAS transition plan
The successful implementation of the AAS-TP milestones is not achieved due to lack of robustness of the general framework (institutional, regulatory, change management, programme management, incentivisation…) or/and Standardisation and regulations bodies not delivering materials (CS, RMT's) on time	• The institutional framework in which these activities will be fulfilled must be clear. As such, boundaries and accountabilities should be defined and applied. • The AAS transition plan provides a realistic roll-out plan. In this context, all the involved stakeholders and institutions will have to be held accountable for the delays they may cause (including knock-on delays) to the full implementation of the AAS transition plan. • A proper project management process, to be operated by e.g. a project manager, will have to be agreed, decided, and implemented to secure timely delivery of the elements of this Transition Plan.	• With the support of the European and national political levels, properly consider the human dimension to ensure the full buy-in of the social partners and the full commitment of involved staff. • ANSPs, airspace users, airports and manufacturers acknowledge their roles ensuring their full commitment to the content agreed upon within the transition plan. • Agree and decide a proper management process, including e.g. the designation of a Project Manager. • Implement proper oversight mechanisms to monitor the activities being undertaken by all stakeholders, but also to properly address whether amendments to the timing or

Risk description	Impact/Consequence	Mitigation actions
		tasks are needed in order to fully deliver the expected results. • Set up an efficient and thorough stakeholder consultation mechanism to ensure coordination among all stakeholders. • Consolidate V4 gap assessment
Delays in implementing mature solutions composing Measure 2 may impact negatively the overall AAS implementation planning.	The timely provision of capacity as required over the coming years would be at risk, leading to increasing delays.	Strict monitoring of the implementation of these Solutions.
Delays in delivering SESAR 2020 key Solutions may endanger the timely implementation of the AAS Measures	If Solutions supporting increase of capacity are not ready on time, they will be increasing delays especially if the foreseen traffic growth is confirmed. The AAS proposes solutions that must be implemented according to the plan to get full benefits.	Secure timely delivery of Solutions related to AAS by securing adequate resources, such as IOP, and provide close monitoring.
There is no or not sufficient Member States support for the proposed AAS implementation, endangering the timelines and coordinated implementation	Risk of non-achievement of the operational goals of the AAS	• Early and high-level / political consultation of Members States' Ministries for Transport • Early consultation of NSAs • Consultation of Member States through Single Sky Committee, EASA Committee and Eurocontrol Provisional Council within their respective responsibilities
Lack of operational use of new Solutions	Delay in the return of early investments and in increase of operational performance.	Early design of operational processes along with industrial Solutions.

Appendix C Master Plan Level 3 update

C.1 Introduction

The Executive view of the proposed Master Plan 2019 already reflects the conclusions and recommendations of the AAS. This integration work is the reason why the Master Plan's transmission for SESAR JU Board's adoption was kept on hold until April 2019. It is now important that the same work is carried out at Master Plan's Implementation view level. Accordingly, the Master Plan Level 3 implementation plan for 2019 has been updated to secure full alignment with the AAS and in particular:

- Identify and highlight the technological Solutions that are mature or "approaching maturity" for implementation by 2025;
- Associate them with an implementation objective when they are mature or an outline description when they are only "approaching maturity.

The specific changes made to the draft ATM Master Plan Level 3 implementation plan for 2019 to reflect the AAS transition strategy is provided in this Appendix. Compared to the draft Level 3 implementation plan, that had already been reviewed by stakeholders, no additional implementation commitments are defined at this stage. Many elements of the AAS that relate to mature solutions are already covered by existing implementation objectives, while for a small number of Solutions that are approaching V3 maturity, at this stage only outline descriptions have been introduced. These would need to be converted into proper implementation objectives in the next update cycle of the level 3 implementation plan, using the agreed governance processes.

C.2 Summary of update proposal

The translation of the relevant part of the AAS transition strategy into the Master Plan level 3 (LVL3) has led to the following changes compared to the previously existing draft LVL 3 Plan:

C.2.1 Executive summary:

- Re-writing of the part "The Airspace Architecture Study Transition Plan"
- addition of 2 new Major ATM Changes: ATM Systems and Virtualisation (this should solve some issues of inconsistency encountered with the previous edition)
- Addition of references to AAS TP Milestone elements (AM-#) in the tables of the Executive Summary.

C.2.2 Strategic View:

- Partial re-writing and repositioning of section Airspace Architecture Study (AAS) Transition Plan in MPL3 Plan (now at the beginning of the Strategic View chapter);
- Addition/editing of tables showing the Milestones addressed by the AAS-TP, and Milestone elements with associated Implementation Objectives, SESAR Solutions or SESAR projects, where applicable (per Phases: 2020-2025; 2025-2030; 2030-2035);
- Modification of the tables of the 4 Key Features mapped to the Major ATM changes, with addition of SESAR 2020 Wave 1 period, and addition of references to Milestone Elements [AM-n.m];

- Addition of 2 ATM Major Changes (ATM Systems (in Key Feature AAS); and Virtualisation (in Key Feature EAI) and modification of the others to reflect these additions;

- For each Strategic View, addition of a section specific to link to AAS-TP; and addition of specific roadmap (table) showing Objective, link to SESAR Sol., link to Milestone element, planned FOC date, current progress (in %, from MPL3 Report) and expected achievement date based on individual ANSPs/States declarations.

C.2.3 Deployment View:

- Per each Key Feature, amended the summary table to include reference to Milestone elements addressed by the individual Implementation Objectives;

- In the Deployment View description of each Implementation Objective, added the reference to the AAS Milestone Element addressed (if relevant).

C.2.4 New Outline Description chapter

Including the description of 5 Outline Descriptions for the period 2020-2025, covering the gaps identified so far and requiring an Implementation Objective.

C.2.5 Annexes:

- Modification of Annex 3 (Annex 3. Relevant mappings of the Level 3 Plan 2019) to add links to Milestone Elements;

- Addition of Annex 5: MPL3 Plan Roadmap with reference to AAS TP. This is the aggregated view of all the individual blocks shown in each Strategic View.

C.3 Coverage of AAS Transition Milestones in Master Plan Level 3

The following table captures the extent to which the AAS Milestones are covered by the Implementation planning in the (latest draft) Master Plan level 3. The assessment of the milestones achievement by indicated AAS phase was done in coordination with SDM assessing current status of corresponding MPL3 implementation objectives and SDP families.

AAS-TP Phase		AAS Milestone	SESAR Solution	MPL3 Objective	Stakeholder						SDP Family
					ANSP	APO	USE	ECTL NM	MIL	NSA/REG	
2025	AM-1.1	Air-ground data exchange - CPDLC	Nil	ITY-AGDL	■		■	■	■		6.1.1, 6.1.4, 6.1.5
2025	AM-1.2	Air-ground data exchange – EPP/ADS-C	#115	OD-1							6.1.2
2025	AM-1.3	G/G connectivity (OLDI including the exchanges for extended AMAN)	#05	ATC17	■						3.2.1 (TBC)
2025	AM-1.3	G/G connectivity	#05	COM11.1	■						No mention
2025	AM-1.3	G/G connectivity	#05	ITY-FMTP	■				■		No mention
2025	AM-1.3	G/G connectivity (OLDI including the exchanges for extended AMAN)	#05	ATC15.2	■			■			Family 1.1.2
2025	AM-1.4	eFPL based on ICAO FF-ICE supporting SBT transition to RBT	PJ.18-02c	FCM08	■		■	■			4.2.3
2025	AM-1.5	G/G Connectivity-SWIM Yellow	#46	INF08.1	■	■	■	■	■		Families AF5
2025	AM-1.6	FRA cross-border above FL310	#66	AOM21.2	■		■	■			3.2.4
2025	AM-1.7	FRA cross-border below FL310	#66 #33 PJ.06-01	OD-2							No mention
2025	AM-1.8	Advanced FUA and ASM Tools, Real time airspace data, Full Rolling ASM/AFTCM	#31	AOM19.1	■			■			3.1.1
2025	AM-1.8	Advanced FUA and ASM Tools, Real time airspace data, Full Rolling ASM/AFTCM	#31	AOM19.2	■		■	■			3.1.2
2025	AM-1.8	Advanced FUA and ASM Tools, Real time airspace data, Full Rolling ASM/AFTCM	#31	AOM19.3	■			■			3.1.3
2025	AM-1.9	Implement Target Times (SAM, API)	#18	FCM07	■	■	■	■			4.3.1; 4.3.2
2025	AM-1.10	Automated support for dynamic sectorisation	#66	AOM21.2	■		■	■			3.2.1
2025	AM-1.11	Occupancy counts and Traffic monitoring volumes exchanges (STAM)	#17	FCM04.2	■		■	■			4.1.2
2025	AM-1.12	Network related data exchanges with operational stakeholders (AOP/NOP interfaces, Aeronautical data, flight plan data, network data)	#20	FCM05	■	■	■	■			4.2.2, 4.2.4
2025	AM-1.13	Data exchange to support traffic complexity	#19	FCM06	■			■			4.4.2
2025	AM1.14	Collaborative Flight Planning (CPR, FSA, AFP)	Nil	FCM03	■			■			4.2.3
		Enhanced tactical conflict detection &			■						

Legend:

	On track, will be deployed by the planned date.
	On track, but requires carefull monitoring (plans need to be consolidated)
	At risk of not being deployed by the dates necessary
	Not assessed, implementation reports not available yet

AAS-TP Phase		AAS Milestone	SESAR Solution	MPL3 Objective	Stakeholder						SDP Family
					ANSP	APO	USE	ECTL NM	MIL	NSA/REG	
2025	AM-1.15	Enhanced tactical conflict detection & resolution (CD&R) services and conformance monitoring tools for en-route	#27 #104	ATC12.1							3.2.1
2025	AM-1.16	Air traffic services (ATS) datalink using iris precursor	#109	OD-3							
2025	AM-1.17	Cooperative surveillance ADS-B / WAM	#114	OD-4							
2030	AM4.1	Dynamic airspace configurations (DAC) - Prerequisites	#44W2	-							
2030	AM-4.2	DAC- flexible sectorisation boundaries dynamically modified based on demand	#44W2	-							
2030	AM-4.3	Collaborative control and multi sector planner (MSP) in en-route	#63 #70W2	ATC18							
2030	AM-4.4	Delegation of airspace amongst ATSUs based on traffic / organisation needs (either static, dynamic or on contingency)	#93W2	-							
2030	AM-4.5	Work station, service interface definition & virtual centre concept	PJ.16-03	OD-5							
2030	AM-5.1	Higher levels of automation in ATC to support full TBO	-	ATC12.1							3.2.1 (TBC)
2030	AM-5.1	Higher levels of automation in ATC to support full TBO	-	ATC18							
2030	AM-5.1	Higher levels of automation in ATC to support full TBO	-	AOM21.2							3.2.1 (TBC)
2030	AM-5.2	Enhanced network traffic prediction and shared complexity representation	#45W2	-							
2030	AM-5.3	Next generation AMAN for 4D environment	#01W2	-							
2030	AM-5.4	Digital integrated network management and ATC planning (INAP)	#48W2	-							
2030	AM-5.5	Improved ground trajectory predictions enabling future automation tools	#53W2	-							
2030	AM-5.6	RBT revision supported by datalink and increased automation	#57W2	-							
2030	AM-5.7	HMI interaction modes for ATC centre	#96W2	-							
2030	AM-5.8	Improved vertical profiles through enhanced vertical clearances	#56W2	-							
2030	AM-5.9	Higher levels of automation supporting sectorless ATCO work	-	-							
2035	AM-8.1	Flight-centric ATC and improved distribution of separation responsibility in ATC	#73W2	-							
2035	AM-9.1	Flight object interoperability and SWIM Blue profile	#28, #46 PJ.18-02b	INF08.2							5.6.1 and 5.6.2
2035	AM-9.2	Dynamic E-TMA for advanced CDO/CCO and improved arrival and departure operations	#08W2	-							
2035	AM-9.3	Enhanced integration of AU trajectory definition and network management processes	#38W2	-							
2035	AM-9.4	Trajectory prediction service	#88W2	-							
2035	AM-9.5	Mission trajectories management with interrated dynamic mobile areas type 1 and type 2	#40W2	-							
2035	AM-9.6	RBT revision supported by datalink and increased automation	#57W2	-							
2035	AM-10.1	De-couple ATS provision, ATM data services, integration services and geographically fixed services	-	-							

Table 3: Master Plan Level 3 coverage of AAS related solutions

Appendix D Analysis of other supporting plans

D.1 Introduction

The conclusions and recommendations of the AAS suggest a phased but substantial evolution of the European airspace architecture and a digital transformation of air navigation service provision. This triggers a re-thinking of the way services are provided, with a view to delivering the capacity needed by airspace users and building a state-of-the-art, scalable and resilient system that will remain at least as safe as today.

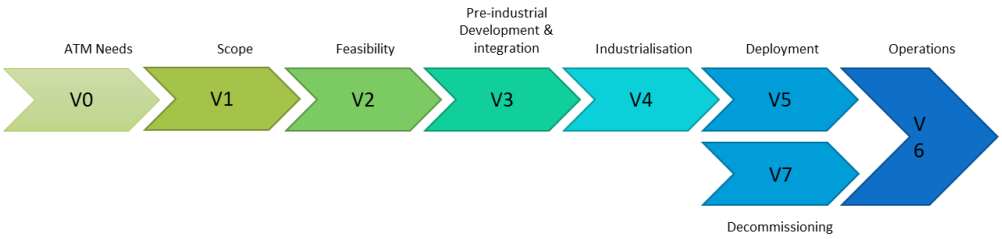
To achieve this it is necessary that all components of the aviation community work in the same direction and at the same pace. This is why it has been deemed necessary to analyse the key documents surrounding the European ATM Master Plan and supporting its implementation, and to identify where amendments or refocus would appear to be desirable.

The

1. Network Strategy Plan (NSP) of the Network Manager,
2. European Plan for Aviation Safety (EPAS) of the EASA,
3. Rolling Development Plan (RDP) of the European ATM Standardisation Coordination Group (EASCG),
4. Deployment Programme (DP) of the SESAR Deployment Manager,

have been analysed and recommendations are provided on how to ensure best alignment with the direction proposed in the AAS. This is detailed in this Appendix.

The lifecycle of improvements to ATM (e.g. through SESAR Solutions) from initial idea to operational use, is organised through a number of different plans, each with their own scope, governance, level of commitment, and reporting mechanisms. The lifecycle model itself, as used for the past two decades can be found in the European Operational Concept Validation Methodology (E-OCVM). **Error! Reference source not found.** below provides an overview of most relevant plans that have been analysed in preparing this AAS Transition Plan.



Scope / Applicable to	What it plans
ECAC stakeholders	ATM Essential Operational Changes/ SESAR Solutions
SJU Members	R&D Execution
ECAC stakeholders	ATM Implementation objectives
EU+	Common ATM (sub-) function deployment
European SDOs for ATM	ATM Standardisation activities
EU+	Aviation Safety rulemaking tasks
ECAC stakeholders	Strategic objectives Network strategic projects
NM + ECAC states	ATM Performance delivery
State/FAB	ATM Performance delivery
State	ATM Stakeholder lines of action
EU and Eurocontrol member states	ATM Operational Performance Delivery activities
ICAO EUR region	ATM Route Network implementation

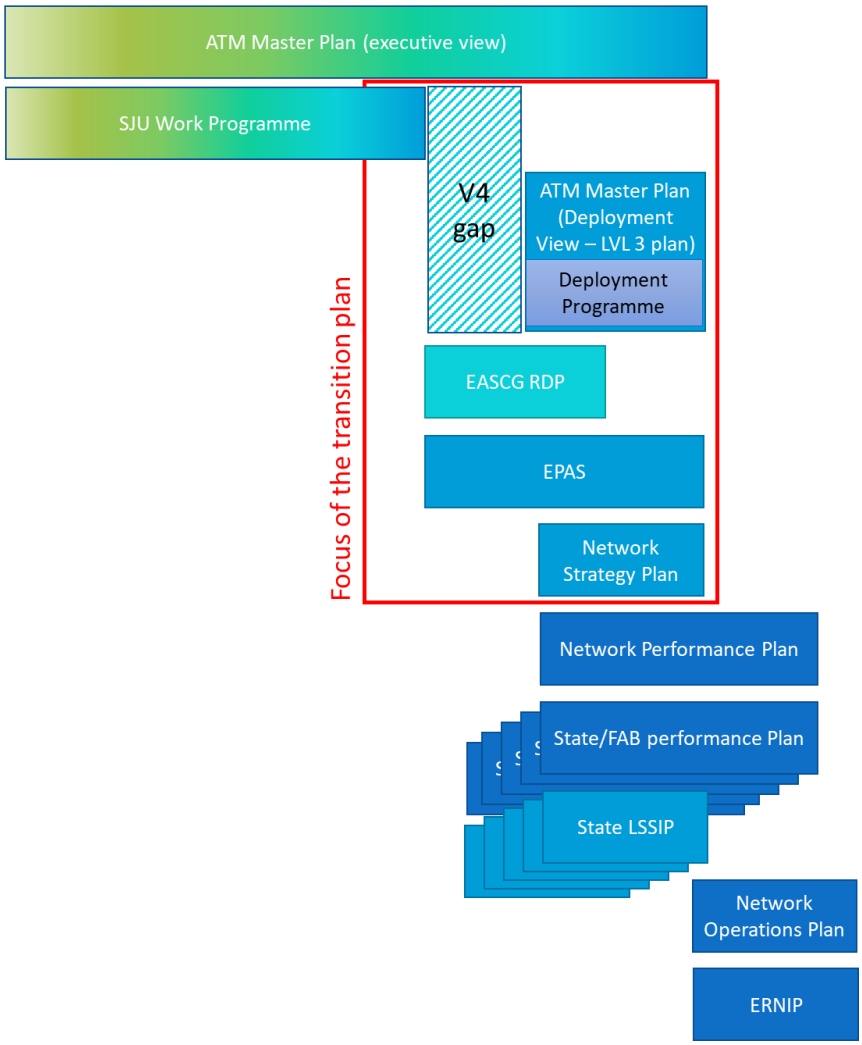


Figure 12: Overview of relevant plans, including V4 gap location

D.2 Network Strategy Plan 2020-2029

The Network Strategy Plan covering the period 2020-2029 and it focuses on the RP3 period. The Network Strategy Plan covers a short/medium term step and a long term step. The Network Strategy Plan shall remain consistent with the Network Functions Implementing Regulation both in its format and scope.

The short term step will ensure Network optimisation in the areas required for the execution of the network functions and tasks, enabled by the joint implementation with all operational stakeholders of major airspace reconfiguration and operational excellence projects, aligned to the outcome of the Airspace Architecture Study; and a better integration of airports and Terminal Airspace Systems into the Network, supported by a new NM system based on innovative digital technologies and on ground-ground and air-ground connectivity.

Step 1: 2019-2025/2029 - Driving Network optimisation through the implementation of airspace restructuring and operational excellence, as described in the Airspace Architecture Study and a better integration of airports and Terminal Airspace Systems into the Network

This aims primarily at achieving a common Network view, optimising operational performance at network level and making the best use of the available - but scarce - human resources, by:

- Setting up an optimum airspace structure that responds to SES performance targets and adaptation of capacity to demand network-wide;
- Optimising sectorisation and airspace structures, in particular at cross-border level;
- Optimised connectivity to Terminal Airspace Systems;
- Improving the flexibility of service provision with by addressing the operational utilisation of resources;
- Improving the capacity planning of week-weekend/nights;
- Implementation of “Operational Excellence” initiatives together with the ANSPs and Airports to further foster operational and technical harmonisation and interoperability. This new initiative would aim at identifying best practices and capture quick wins (through changes in operational procedures, operational utilisation of resources, smaller adaptations to systems, etc.) among all stakeholders and effectively support their implementation to reduce delays;
- Capacity commitment through the NOP will be established between NM and ANSPs consolidating demand capacity balancing optimisation addressing both lack and surplus of capacities considering network and local conditions.
- Improving vertical flight efficiency for reducing gas emissions and fuel consumption;
- Optimising flight planning, airports operations and flow management through the integration of data and constraints. This includes
    - Sharing the main enablers that ensure a common network view (e.g. capacities, trajectories, configurations, activations);

- Improving traffic predictability and the assessment of traffic complexity;
- Consolidating an efficient ATFM set of solutions based on improved traffic predictability and network impact assessment;

- The Network Manager undertaking a vast modernisation of its own system to support all new emerging operational concepts based on the implementation of its Future System Architecture (FUTARS) study.

A specific attention will be put on the performance of - and access to – the most congested airports/TMAs, a sensitive component of the Network. This will involve:

- Improve the efficient use of airport infrastructures through advanced collaborative operations;
- integration of airport and network operations, addressing the links AOP - NOP and the connectivity between APOC and NMOC;
- Advanced airport capacity planning with end-to-end optimisation at network level.

In parallel, all actors will implement the Common Projects components of SESAR. From a Network strategy perspective, the Network Manager will ensure full coordination of AF3 and AF4 Families where most network benefits are expected and where synchronisation will have to be carefully managed.

The first actions required for the Network Functions to support the new ambitions stemming from the Aviation Strategy for Europe will be initiated while responding to the requirements of the NF IR... Additional dimensions of Network performance will be analysed, in terms of connectivity, passenger service, and pace of implementation of environmental friendly technologies and procedures. The Network Manager will enlarge its operational intelligence capabilities to become an observatory in support of the political bodies concerned: collecting the operational data, taking part in the analyses, identifying areas for improvement in coordination with all Network actors and facilitating the analysis and coordination of air transport with other modes of transport for crisis situations. A return from experience will be deduced from these initial actions to further refine, if necessary, the scope of the Network Functions to address those new aspects.

Another cornerstone of this transformation will be to address Infrastructure Evolutions in close cooperation with all actors. It will in particular:

- Monitor the day to day network operational and technical performances to the extent required for the execution of the Network Functions and tasks and the fair sharing of the scarce resources.
- Develop, organise and provide common network support services related to the network functions that are required by operational stakeholders, as stipulated in the NF IR or as otherwise decided through the Network CDM processes.
- Ensure that infrastructure services will meet network performance objectives and address the aviation requirements and spectrum constraints as they evolve (e.g. to support future RPAS operations, and also any other new entrant operations such as Balloons and High Altitude Pseudo Satellites (HAPS)).

Several additional functionalities for Network operational performance with direct benefits for airspace users will be gradually implemented:

- The generalisation of the User-Driven Prioritisation Process (UDPP).

- The implementation of information sharing in support of the business and mission trajectories.
- Digital integrated briefing.
- Full implementation of Extended Projected Profile (EPP).
- Progressive implementation of Enhanced Collaborative Airports Performance Management, and
- The gate to gate optimisation with airside-landside integration.

This will require to be facilitated by an extensive dialogue amongst operational stakeholders with regard to potential improvements in the regulatory framework as well as by the implementation of those more structural/institutional changes in the areas of:

- Harmonised ATCO licensing;
- Harmonised conditions of employment;
- Refinement of the route charging model;
- Enhanced coordination between all actors to simplify and further integrate Network Functions and tasks from R&D, industrialisation, implementation into operations;
- Optimised integration of civil-military activity and requirements.

D.3 Deployment Programme 2018

The Deployment Programme 2018 (DP 2018) provides the detailed view on the implementation of the PCP and represents a further breakdown and update of the requirements stemming from the Pilot Common Project Regulation and clearly defining the scope of the related implementation activities, as well as the suggested approach to be followed. 2018 consists of 48 families detailing the scope, features and main attributes of the implementation activities in a consistent work breakdown structure. Most of the SDP 2018 families address the core PCP requirements, some of them the PCP pre-requisites as well as the additional implementation activities closely linked with PCP requirements. The SDP 2018 horizon is year 2025, as the last Full Operational Capability (FOC) date for 48 Families is 01/01/2025, except the airborne equipage for family 6.1.2 (ATN B2 based services in ATSP domain) with 2026 as FOC date.

Starting from AAS recommendations and requirements associated with the 2025 horizon, the analysis performed consists of the identification of gaps with the corresponding elements of the PCP, which is at the origin of the SDP 2018.

Only those AAS elements linked with PCP requirements have been taken into consideration.

As the whole scope of AAS milestones concerning the 2025-2030 time horizon is not relevant for SDP 2018 coverage, only an initial assessment of pre-requisites associated with these milestones has been conducted.

The AAS proposes three high level milestones within the 2025 time horizon:

- ECAC-wide implementation of cross-border free route, air-ground and ground-ground connectivity;
- Complete airspace re-configuration supported by an operational excellence programme to capture quick wins;

- Set up an enabling framework for ATM data service providers, capacity-on-demand service and rewards for early movers, first ADSP is certified;

The first two milestones are relevant against the SDP 2018 requirements, while the third milestone covers institutional and regulatory aspects and therefore is not part of the analysis.

The two relevant AAS milestones have been further broken down into their constitutive elements, which, in turn, have been mapped to the corresponding SDP 2018 families. The result is consolidated in the table below.

AAS Milestone elements	**SDP 2018 requirements**	**Identified gaps and recommendations**
FRA above FL310	Fully covered by family 3.2.4	None
FRA cross-border	Covered by the PCP review proposal from SDM. As the timing for SDP 2019 is not sufficient to consider the PCP review, the coverage of FRA cross-border aspects should be considered for SDP 2020.	Gap, FRA cross-border aspects to be addressed by SDP 2020, pending EC decision on PCP review proposal.
FRA to ensure connectivity with TMA	Covered by the PCP review proposal from SDM. As the timing for SDP 2019 is not sufficient, this should be considered for SDP 2020.	Gap, FRA connectivity with TMA to be addressed by SDP 2020, pending EC decision on PCP review proposal.
System support for National, cross border and lower airspace FRA implementation	Fully covered by family 3.2.1, this family addresses the system and tools required for different FRA implementations (national, cross-border, connectivity with TMA)	None
AFUA and ASM	All ASM and AFUA requirements are well covered by families 3.1.1, 3.1.2 and 3.1.3. Family 3.1.4 (Management of dynamic airspace configurations) supports the AAS milestones beyond 2025.	None
Ground/Ground legacy exchanges	Basic OLDI and SYSCO are covered by family 3.2.1, while the legacy protocols are listed in family 5.2.2	None
Ground/Ground data exchanges with NM	Mostly covered by family 4.2.3 (FSA, AFP, CPRs) and family 4.4.2 (EFD). The eFPL exchanges need to be included and to be reflected in the next SDP editions, in line with the PCP review proposal from SDM.	Partial gap, eFPL based on ICAO FF-ICE to be addressed by SDP 2020, pending

AAS Milestone elements	SDP 2018 requirements	Identified gaps and recommendations
	The NM exchanges with airports are part of family 4.2.4	EC decision on PCP review proposal.
Ground/Ground connectivity SWIM Yellow Profile	Fully covered by families 5.3.1, 5.4.1, 5.5.1 and 5.6.1. Family 5.6.1 needs to be amended to reflect the exchange of eFPL. The operational content of Network related SWIM exchanges is covered by families 4.1.2, 4.2.1 and 4.3.1.	Partial gap, eFPL to be linked with family 5.6.1.
Ground/Ground connectivity SWIM Blue Profile	Covered by family 5.6.2, although it should be noted that the maturity of this family is very low, pre-requisites are missing and validation activities are still needed to demonstrate the readiness for implementation. The SWIM Blue profile is subject of PCP review and more detailed recommendations can be defined when the mature draft of the PCP review is available	None for the time being
Air/Ground Data Link exchanges	The AGDL implementation including the multi-frequencies data link network is fully covered by families 6.1.1 and 6.1.3. The airborne elements are covered by Family 6.1.4	None
Air/Ground Trajectory exchanges	The ADS-C and EPP are fully covered by family 6.1.2	None
Airspace re-configuration supported	The technical enablers to support airspace reconfiguration are covered by families 3.1.4 and 3.2.1. However, the airspace reconfiguration mainly addresses the airspace design issues, covering the identification of network efficiencies and delivery of optimised airspace structures based of free route traffic flows. These activities fall within the scope of NM and as such, they do not need to be reflected in SDP 2018.	None
Operational excellence programme	This is not covered by SDP 2018. Nevertheless, since this element aims at identifying best practices via procedural, staffing and system improvements and support the implementation in order to reduce ATFCM delays without direct links with any requirements stemming from the PCP IR, it cannot be reflected in any further edition of the SDP.	None

Table 4: overview of gaps and recommendations related to the Programme

The FOC timing for the SDP 2018 families related to AF3 and AF4 seems adequate (end of 2021), although the upcoming PCP revision might impose different timing for FRA cross-border aspects. The timing for SDP2018 related to AF5 and AF6 is a bit tight (end of 2025), but the validation activities for some elements of these families are on-going and bringing the FOC closer may not be adequate. However, all elements for SWIM yellow profile related to aeronautical and Network exchanges are in place; therefore, the Operational Stakeholders might considered implementing these elements before the FOC dates.

The AAS proposes four high level milestones for the 2025-2030 time horizon:

- Implement virtual centres and dynamic airspace configuration at large scale;
- Gradual transition towards higher levels of automation
- Capacity-on-demand arrangements implemented across Europe
- New ATM Data service provision model is implemented across Europe

The pre-requisite for the first two milestones are assessed against the SDP 2018 requirements, while the remaining two milestones cover mostly institutional and regulatory aspects and therefore they have not been considered for the analysis.

The Dynamic Airspace Configuration (DAC) is fully covered by SDP 2018 (family 3.1.4). As some DAC validation activities are still on-going, the content of SDP 2018 family 3.1.4 might need to be revisited and adapted in accordance with the outcome of these validations, although the core DAC part is already covered. In the terms of DAC pre-requisites, the SDP 2018 provides sufficient coverage.

The pre-requisites for virtual centres in terms of data interoperability and ground –ground data exchanges are also well embedded in different families of SDP 2018 as elaborated above. The SWIM Blue profile functionalities might not be essential as they could potentially be compensated by the legacy exchanges. The remaining part of virtual centres in terms of infrastructure layers, technical components, operational procedures and organisational arrangements are outside of the PCP scope and therefore also of the scope of the Deployment Programme .

The AAS listed the set of automation and productivity tools together with the corresponding solution projects that could support the achievement of high-level milestones for gradual transition towards higher level of automation. SESAR 1 validated the majority of automation solutions (although most of them have been industrialised before SESAR) and as such, they are part of the PCP IR. The PCP related automation tools (MONA, MTCD, CORA, CDT and system support for extended AMAN) could be considered as pre-requisite to achieve the second 2025-2030 AAS milestone and they are well reflected by different SDP 2018 elements (family 3.2.1, family 1.1.2, families belonging to AF4). The ATC automation solutions that are in the validation pipeline offer only incremental improvement of existing automation tools and changes that are more radical might be needed. . Additional R&D activities might also be needed to explore the next level of ATC automation.

RECOMMENDATIONS

In order to ensure the AAS alignment with future Deployment programme editions, it might be appropriate that DP addresses the following items:

- FRA cross-border aspects

- FRA connectivity with TMA
- eFPL based on ICAO FF-ICE

These requirements are included in the proposed revision of the PCP IR made by SDM to the Commission and will be reflected in the corresponding editions of Deployment Programme, after Commission review and approval.

In addition, the following considerations need to be highlighted, some are already addressed by the Deployment Programme Planning View 2019 edition:

- In order to pave the way for the high level AAS milestones 2025-2030, the Operational Stakeholders might consider to speed up the implementation of SWIM yellow profile aeronautical and Network related data exchanges;
- Looking to allow a timely start for the gradual implementation of higher ATC automation levels, the Operational Stakeholders should also consider accelerating the implementation of system support for Extended AMAN ahead of the 2024 FOC date;
- More focused R&D activities related to automation tools should be considered in order to ensure the advent of the next generation of automation tools.

D.4 Draft European Plan for Aviation Safety (EPAS) 2020-2024

The European Plan for Aviation Safety (EPAS) provides a proactive approach to support the future growth of aviation while securing a high and uniform level of safety and environmental protection. The EPAS is to evolve towards a more integrated approach, supporting the management of different types of risks (safety, security, capacity, and environment) across the total aviation system supporting innovation. As the plan is updated on a yearly basis, the current tasks described in paragraph 15.3 of the draft EPAS 2020-2024 will be continually reviewed and updated including the introduction of new tasks, when appropriate and in accordance with the existing processes. The analysis of the draft EPAS 2020-2024 covered in this Section has focussed on elements in the AAS that could imply the use or updates to existing tasks. The analysis is based on the AAS; however further details, including quantified impact assessment by SJU, will be needed in order to perform more precise evaluation of the plan. In the table below the left column captures elements of the AAS report that may relate to existing EPAS elements in the right-hand column and the remarks in the third column.

AAS element	Corresponding EPAS task	Remarks
Air Traffic Controllers		
Changes in current ATCO practices from sector oriented to flight/flow oriented operations as well as demand based cross-border dynamic sector operations	RMT.0668 regular Update of ATCO licensing rules (IRs/AMC/GM) RMT.0719 regular update of ATM/ANS CRs (with regard to PART-ATS)	It is considered that the current regulatory package is sufficient for the implementation of the AAS element. Possible need for implementation support by providing some additional GM. If the elements are significant, new ToR will be needed and a new task will be initiated accordingly. RMT.0719 could be used to address the aspects relevant to the technical requirements for flight/flow oriented operations. However if significant maybe separate task will need to be initiated.
Cyber Security		
Need to ensure strong protection of data against cyber security treats. A number of guiding principles should be defined for the organisational and technical measures that are needed to encourage cyber resilience. Cyber security practices in ATM will need to be adapted to comply with the relevant European regulatory framework that is not always aviation specific: GDPR, NIS Directive, and EC 373/2017.	RMT 0720 Management of information security risks SPT.071 Strategy for cybersecurity in aviation	The work of RMT.0720 is expected to deliver an EASA Opinion in Q3 2020. Possible adoption of the relevant IR in 2021. The future developments should comply with the relevant IR. Covered in the current draft EPAS.

Common requirements for providers of ATM/ANS services and other ATM network functions and their oversight Reg (EU) 2017/373		
Specific requirements for certification and oversight of ATM Data Providers.	RMT.0719 Regular update of ATM/ANS Rules (IRs/AMC&GM)	Currently the ToR of RMT 0719 foresees provisions to start working on the ADSP concept (introduction , evolution of new concepts/ technologies)
Interoperability		
Datalink Services, including • Extended projected profile (EPP) availability on ground #115 • Conformity with interoperability requirements	RMT.0524 Datalink Services RMT.0161 Conformity assessment	For the time being the RMT.0161 is being initiated.
SESAR 2020 Wave1 • Flight object interoperability PJ.18-02b • eFPL supporting SBT transition to RBT PJ 18-12c • Work station, service interface definition & virtual centre concept PJ 16-03	RMT.0682 Implementation of the regulatory needs of the SESAR projects. DA/AMC/GM	The task is foreseen in the draft EPAS. Assessment of the regulatory action is necessary on a case by case basis of each solutions when mature.
SESAR 2020 Wave 2 • Dynamic E-TMA for advanced continuous climb and descent operations and improved arrival and departure operations CS #8 • Enhanced integration of AU trajectory definition and network management processes CS #38 • Dynamic airspace configurations (DAC) CS #44 • Collaborative control and multi sector planner en-route (MSP) CS#70	RMT.0682 Implementation of the regulatory needs of the SESAR projects. DA/AMC/GM	The need for additional RMTs other than RMT.0682 is to be assessed at a later stage when the solutions and concepts are mature.

• Delegation of airspace amongst ATSUs CS #93 • Extended arrival management (AMAN) horizon CS #5 • Transition from calculated take off time (CTOT) to CTOT & target time arrival (TTA) CS #18 • Enhanced network traffic prediction and shared complexity representation CS #45 • Next generation AMAN for 4D environment CS #1 • Digital integrated network management and ATC planning (INAP) CS #48 • Improved ground trajectory predictions enabling future automation tools CS #53 • RBT revision supported by datalink and increased automation CS #57 • HMI interaction modes for ATC centre CS #96 • Improved vertical profiles through enhanced vertical clearances CS #56 • Delegation of airspace amongst ATSUs CS #93 • Flight-centric ATC and improved distribution of separation responsibility in ATC CS #73 • SWIM TI green profile for G/G civil military information sharing CS #101 • Trajectory prediction service CS #88 • Mission trajectories management with integrated dynamic mobile areas type 1 and type 2 CS #40		

• Generic controller validations CS #73 • FCI terrestrial data link and A-PNT enabler (L-DACS) CS #60 • Integrated CNS and spectrum Cs #76 • FCI services CS #77		

Table 5: Analysis of possible impact on EPAS (draft 2020-2024)

D.5 EASCG European Standardisation Rolling Development Plan (RDP)

A preliminary assessment has been made of the AAS report content in relation to existing and already foreseen standardisation material (e.g. standards, guidance, and certification specifications). A number of existing standards were already explicitly referenced in the AAS report. The assessment considers the impact on the EASCG Rolling Development Plan (RDP) to identify any gaps.

An initial list of standards in support of the AAS target architecture, covering all three Measures are listed below in Table 6. It identifies subject areas described in the AAS report where standards would support the target architecture implementation. Additional columns provide the state-of-play, a non-exhaustive list of associated standards within the scope of AAS, traceability to the Master Plan Level 3 and assessed impact on the RDP. The assessment proposes a new standard for Measure 3 currently entitled “Specification on ATM Data Service Definition and Requirements” which encompasses the standards (inter-ADSP and ADSP-ATSP standards) illustrated in Figure 11. The elaboration of this standard will depend on the availability of various inputs (e.g. CONOPS on virtual centres, harmonised operational concepts, Service-Oriented Architecture definition, Business models, legal liabilities applicable to ATS and DS providers, charging scheme review for capacity on-demand services), some of which will be delivered by the S2020 R&D activities, while others would be expected from the regulatory and business model analyses being performed by the EC.

Numerous operational procedures and implementation approaches could be standardised but would be better documented in the form of “best practices”. Table 7 provides the results of the assessment with the same layout as the first. In particular, such guidance material will directly support the foreseen Operational Excellence Programme.

In summary, for Measures 1 and 2 (short-term):

- eFPL standardisation is in its final stages and NM has already integrated its support. ICAO material is on track for publication by 2021 followed by an updated IFPS User’s Manual and the integration of military requirements (iOAT Flight Plan).
- The integration of downlinked EPP data into flight data processing systems of air traffic service providers and NM is considered a local matter in the existing ATM system configuration but will need standardisation when introducing flight object interoperability and ATM Data services. EASA is currently updating the A-CNS Certification Specification within RMG.0524.
- The needs for improved interoperability requirements and productivity tools are expected to be achieved through the full implementation of existing standards.

- The need for ATM specific Cybersecurity standards needs further inputs from R&D and implementation activities. It is expected that this in general the application of common IT security standards will suffice, complemented by those under development as documented by the ICAO SSGC, ECSCG and global best practices.

In summary for Measure 3 (medium/longer term):

- A new standard on "ATM Data Service Definition and Requirements" is foreseen but depends on the availability of a series of input documents and potential regulatory actions. This corresponds to Figure 11, Measure 3, inter-ADSP and ADSP to ATSP standards.
- Continued evolution of the standardisation material associated to Measure 2, notably the evolution of the SWIM yellow profile to extend with the green profile requirements.

LIMITS OF THE ANALYSIS AND NEXT STEPS

Due to the limited time available to develop this transition plan only a preliminary analysis could be performed. It should serve as an input to a robust and comprehensive gap analysis that should be performed by the European ATM Standards Coordination Group (EASCG) to provide:

- A list of all standards available today to support a quick implementation of the different measures related to the ASS TP
- A list of still required standards to fill the gap to the full AAS TP extend.
    - This will be the bases to transform the needs into the different work programmes of the appropriate SDO and therefore result in an update of the RDP.
    - This will also show clearly where the community needs to invest resources, expertise and effort to develop theses required standards in order to close the V 4 gap

The EASCG will report back to the SJU Master Plan Committee (MPC) on these deliverables and will make them publicly available on their website www.eascg.eu.

1. Standards/Specifications

Subject matter identified from the AAS Report (bold underlined)	Status	Related material (non-exhaustive)	ATM MP Level 3 Reference	EASCG RDP Impact
eFPL (based on FF-ICE) Extended flight plan (EFPL) listed in the AAS report is superseded by eFPL (based on FF-ICE).	Standards being finalised	ICAO: Annex 2&15 SARPS (ready 2021), Doc 9965 Vol2 guidance (ready 2021), Doc 7030, FIXM (ready) ECTL: IFPS User's Manual, IFPS Spec	FCM08	No
Extended projected profile (EPP)	Standards available	ICAO: GOLD (Doc 10037) ECTL: SWIM Specs, MTCD/MONA/TP Specs (Safety Nets) EUROCAE: ED-228A EASA: A-CNS Cert Spec (a draft of the update is available - RMG.0524)	OD-1, INF08.1, INF08.2, ATC12.1	No
Increased ATC interoperability Added new functionality to OLDI in particular support for FRA, consistent view of flight at all times.	Standards available	ICAO: AMHS (EUR Doc20) ECTL: OLDI, NM B2B, SWIM (Yellow profile integration of green profile) EUROCAE: ED133 (update)	ATC-17, COM10, INF08.1, INF08.2	SWIM TI yellow profile evolution (AAS Measure 3), potential update[18] of other standards in RDP
Extension of A-FUA for dynamic airspace configuration	Standards available	ECTL: FUA Spec, SWIM Specs, ASM Specs, ERNIP (actions relating to FUA)	OD-2, INF08.1, INF08.2, AOM19.1, AOM19.2, AOM19.3	Potential update of standards listed in RDP
Automation and productivity support Add or clarify functionality to existing standards. Airport automation and productivity are out of scope.	Standards available	ICAO: GOLD (Doc 10037) ECTL: MTCD, MONA, TP Specs (Safety Nets), OLDI Spec, SWIM, NM B2B, IFPS User's Manual	ITY-AGDL, ATC12.1, ATC17 AOP05, AOP04.1, AOP04.2, AOP12, AOP13, AOP16, AOP18	Potential update of standards listed in RDP

[18] Potential update of Standards: It is assumed that any further need for harmonisation can be achieved by fully implementing existing material. Minor updates to standards may be required by the Programmes.

Subject matter identified from the AAS Report (bold underlined)	Status	Related material (non-exhaustive)	ATM MP Level 3 Reference	EASCG RDP Impact
New standard on ATM Data Service Definition and Requirements A framework standard defines functional and interoperability requirements applicable to services entities/providers (see AAS Report Fig 18, Table 5). Includes QoS parameters, performance, interfaces, harmonised SLAs, virtualisation. The standard will support EASA regulatory action for ADSPs, certification, procurement and performance monitoring.	New, proposed standard for Measure 3	ICAO: GOLD (Doc 10037), AMHS (Eur Doc 20), PBN Manual (Doc 9613) ECTL: SWIM specs, ADQ Specs, TP Spec, AMHS Spec, FMTP spec, PENS, datalink, PBN Handbooks EASA: A-CNS Cert Spec, Part-AIS Industry: open standards EUROCAE: ED-133 (to be updated)	COM10, NAV03.1, NAV03.2, NAV10, NAV12, INF08.1, INF08.2, ITY-FMTP, COM12, ITY-AGDL	New, proposed new entry for RDP (AAS Measure 3)
Cyber-security Procedures, Measures and Training Covers both A/G and G/G information exchanges. Standards derived from application of GDPR, NIS Directive, Reg (EU) 2017/373	Standards available	ICAO: Annex 17 CEN: EN16495 ISO/IEC: 27000 series ETSI: TSs/TRs Industry standards		No (see ECSCG RDP)
Cross-border ATS provision, licensing, capacity-on-demand service, contingency and training	Standards available	EASA: ATCO Easy Guide (consolidates IR/AMC/GM), Easy Access Rules for ATM-ANS Annex XIII (ATSEP) ECTL: ATSEP CCC Training Spec (for parts not covered by EASA Easy Access Rules) ICAO: Doc 10056 and 10057		No

Table 6: Possible impact of AAS elements on standards material in the EASCG RDP

2. Guidelines

While (updated) standards are essential for some ATM developments, many other aspects can equally well be supported by provision of guidelines. Even if guidelines are not covered as such by the EASCG rolling development plan, the table below nevertheless provides a list of AAS topics for which the development of (updated) guidelines should be considered.

Subject matter identified from the AAS Report	Status	Related material (non-exhaustive)	ATM MP Level 3 Reference	EASCG RDP Impact
Guidelines for military operators relating to eFPL implementation (eFPL iOAT FPL)	New (in progress)	ECTL: IFPS User's Manual	FCM08	N/A
Guidelines on demand-based cross-border dynamic sectorisation and sector operations	New		OD-2	N/A
Guidelines on cross border contingency arrangements for Data Service Providers	New or potential update of guidelines	ECTL: Amendment to Guidelines for Contingency Planning of ANS		N/A
Guidelines in support of automation and productivity support	Potential update of guidelines	ECTL: Amendment to Guidelines on MTCD, MONA, TP Guidelines (Safety Nets), OLDI	ATC12.1 ATC17	N/A
Verification of compliance and conformance monitoring (incl. certification, conformity assessment and oversight)	New EASA conformity assessment regulations (RMT.161) and updated guidelines	ECTL: CA guidelines, contingency guidelines, monitoring tools (Spectrum, Freq, RVSM etc.) EU: Community Specs, NSA guidelines		N/A

Table 7: Possible needs for (updated) guidelines related to AAS elements

Appendix E Terms of Reference of the two programmes to be launched

The content of this Appendix refers to Measure 1 presented in Section 2. The proposal for these two Terms of Reference has been coordinated by the Network Manager.

E.1 Airspace Reconfiguration Programme

E.1.1 Purpose

The Airspace Reconfiguration Programme is created in order to deliver the re-design of the ECAC airspace to address future capacity and flight efficiency challenges. It is covered by the provisions of the Network Functions implementing Regulation with respect to the ERND function. It will contribute to the fulfilment of the requirements arising from the relevant Single European Sky Implementing Rules and will address operational performance requirements for RP3. It will be established in full continuity with the actions already agreed through the NM's "7 Measures for 2019" and more specifically with the action "Addressing Airspace Structural Bottlenecks".

The Airspace Reconfiguration Programme will be implemented gradually and will take into consideration other major projects under development and implementation.

In accordance with Commission Regulation (EU) No 123/2019 (laying down the detailed rules for the implementation of air traffic management (ATM) network functions), the Airspace Reconfiguration Programme will contribute to:

- Delivering airspace solutions and interfaces required to facilitate operational interconnectivity within the ECAC airspace and at its interfaces to ensure the required level of operational performance;
- Supporting the different operational stakeholders within the obligations that are put to them in the development and implementation of the European Route Network Improvement Plan and in deploying relevant actions in accordance with the European ATM Master Plan.

E.1.2 Principles

The Airspace Reconfiguration Programme will organise its work based on the airspace design principles laid down in the EC Regulation No 123/2019, Annex I, Part C:

"When developing the European Route Network Improvement Plan, the Network Manager, Member States and air navigation service providers, acting as part of functional airspace blocks or individually, shall, through cooperative decision-making, adhere to the following airspace design principles:

(a) the establishment and configuration of airspace structures shall be based on operational requirements, irrespective of national or functional airspace block borders or Flight Information Region (FIR) boundaries, and shall not be constrained by the division level between upper and lower airspace;

(b) the design of airspace structures shall be based on a transparent process allowing to consult the decisions made and understand their justifications and shall take into account the requirements of all users whilst reconciling safety, capacity, environmental aspects and having due regard to military and national security needs;

(c) the present and forecast traffic demand, at network and local level, and the performance targets shall be the input for the European Route Network Improvement Plan with a view to satisfying the needs of the main traffic flows and airports;

(d) ensure vertical and horizontal connectivity, including terminal airspace and the airspace structure at the interface;

(e) the possibility for flights to operate along, or as near as possible to, user required routes and flight profiles in the en route phase of flight;

(f) the acceptance for assessment and possible development of all airspace structures proposals, including Free Route Airspace, multiple route options and Conditional Routes (CDRs), received from stakeholders having an operational requirement in that area;

(g) the design of airspace structures including Free Route Airspace and ATC sectors shall take into account existing or proposed airspace structures designated for activities which require airspace reservation or restriction. To that end only such structures that are in accordance with the application of the Flexible Use of Airspace (FUA) shall be established. Such structures shall be harmonised and be consistent with the largest possible extent across the entire European network;

(h) ATC sector design development shall commence with the required route or traffic flow alignments within an iterative process that ensures compatibility between routes or flows and sectors;

(i) ATC sectors shall be designed to enable the construction of sector configurations that satisfy traffic flows and are adaptable and proportionate to variable traffic demand;

(j) in cases where for operational reasons ATC sectors require to be designed across national or functional airspace block borders or FIR boundaries, agreements on service provision shall be established between the operational stakeholders concerned.

The Network Manager, Member States, functional airspace blocks and air navigation service providers (the latter acting as part of functional airspace blocks or individually), shall, through cooperative decision-making, ensure that the following principles apply to airspace utilisation and capacity management:

(a) airspace structures shall be planned to facilitate flexible and timely airspace use and management with regard to routing options, traffic flows, sector configuration schemes and the configuration of other airspace structures;

(b) airspace structures should accommodate the establishment of additional route options while ensuring their compatibility with the existing capacity considerations and sector design limitations."

E.1.3 Criteria and assumptions

The Airspace Reconfiguration Programme will work on the basis of the following criteria and assumptions:

(a) Design of an optimum airspace structure based on cross-border FRA and, if required, ATS route network below FRA;

(b) Ensuring TMA connectivity (including TMAs covering several airports) and CCO/CDO operations, re-organisation of airspace above FL410, re-consideration (if necessary and in cooperation with all operational stakeholders), of the airspace classification (on the basis of the ICAO classification), gradual integration of new entrants, etc.;

(c) Definition of optimum sectorisation;

(d) In order to avoid frequent airspace changes, utilisation of high traffic forecast to deliver a future-proof sectorisation;

(e) Capacity and environment/flight efficiency performance;

(f) For design and operations, European airspace as a single airspace;

(g) Addressing lower and upper airspace and TMA connectivity;

(h) Including all the evolving military requirements and other national requirements;

(i) Accommodate operational needs of airspace users to the largest possible extent;

(j) Ensure early alignment and close cooperation with the Computer Flight Planning Service Providers (CFPS)

(k) Align with the ERNIP Part 1 Technical specification for airspace design methodology and requirements;

(l) Stepped implementation over RP3 converging towards the target plan.

E.1.4 Role

Within the framework provided by the SES regulations, the Airspace Reconfiguration Programme will ensure the co-ordination for airspace design and development, planning and implementation of improved free route airspace, ATS route network, optimised civil and military airspace structures, ATC sectors and airspace utilisation and availability. The Airspace Reconfiguration Programme will carry out its work within the Network CDM Processes in cooperation with all operational stakeholders.

The Airspace Reconfiguration Programme shall:

a) Ensure the development of an optimised airspace structure as a Target Plan;

b) Cover aspects related to the development, optimisation and co-ordinated implementation of cross-border free route airspace, ATS route network, en-route and TMA airspace structures, ATC sectors and airspace utilisation and availability;

c) Ensure TMA connectivity (including TMAs covering several airports) and CCO/CDO operations, re-organisation of airspace above FL410, re-consideration (if necessary and in cooperation with all operational stakeholders), of the airspace classification (on the basis of the ICAO classification), gradual integration of new entrants, etc.;

d) Ensure the development and consolidation at ECAC level of short, medium and long term airspace development and implementation plans over the period 2020-2025;

e) Ensure the availability of quick wins for implementation as from Summer 2020;

f) Ensure the collection, consolidation and accommodation of civil and military airspace users short, medium and long term airspace design requirements and needs;

g) Identify airspace design and utilisation-related operational bottlenecks and the mitigation solutions thereto;

h) Identify operational resources required to deliver the required operational performance with the respect to the new sectorisation;

i) Include, as required, operational stakeholders, including military, in fast and real time simulation activities when those are deemed necessary;

j) Include in its activities the coordination requirements arising from other airspace plans in the ECAC area.

E.1.5 Composition

The participants in the Airspace Reconfiguration Programme shall be civil and military experts in airspace design and airspace utilisation, operational experts from ECAC member States and their ANS providers, as well as civil airspace users and airport representatives. The membership shall be constituted by the participants in the ERND Network CDM Processes.

E.1.6 Airspace Reconfiguration Programme completion criteria

Consistent implementation of cross-border Free Route Airspace and optimised sectorisation for the entire ECAC airspace providing an appropriate response to the RP3 targets. Monitoring will be executed through NOP and ERNIP and through the specific RP3 monitoring processes.

E.2 Operational Excellence Programme

E.2.1 Purpose

The Operational Excellence Programme is created to complement the development and implementation of the new sectorisation projects. It is covered by the Network Functions implementing Regulation through a large number of tasks included for the Network Manager. Its aim is to identify and implement best-in-class operational evolutions and deliver minimum common operational capabilities among all stakeholders. This will ensure the achievement of operational and technical harmonisation aligning on best-in-class performance and delivering the expected operational performance in line with the Airspace Architecture Study conclusions. It will contribute to the fulfilment of the requirements arising from the relevant Single European Sky Implementing Rules and will address operational performance requirements for RP3. It will be established in full continuity with the actions already agreed through the NM's 7 Measures for 2019 and more specifically with the action "*Preparation of the Network Operations Plan 2019-2024*". It will also contribute to the implementation of some of the measures approved by the Network Management Board as part of the Network Operations Plan 2019-2024.

The Operational Excellence Programme will be implemented gradually and will take into consideration other major projects under development and implementation. The need to progress towards seamless cross-border operations will also address systems connectivity and interoperability and improvement of operational procedures.

In accordance with the Commission Regulation (EU) No 123/2019 (laying down the detailed rules for the implementation of air traffic management (ATM) network functions), the Operational Excellence Programme will contribute to:

- ensuring that the Network Strategy Plan and the Network Operations Plan contribute to the achievement of the Union- wide targets and associated local performance targets and monitor the implementation of the plans

- initiating, supporting and coordinating cooperation between operational stakeholders in the development and implementation of operational actions to ensure efficient use of available airspace and capacity and reduce network delays;

- identification in the Network Operations Plan all initiatives supporting the development of cross-border coordination and the provision of cross-border air traffic management and air navigation services, highlighting those on which the delivery of the Network Performance Plan is particularly dependent;

- providing a consolidated and coordinated approach to all planning and operational activities of the network, including monitoring and improvement of the overall network performance in order to improve network efficiency, interoperability and connectivity;

- supporting operational stakeholders in executing their obligations that are placed on them, in deploying air traffic management or air navigation services (ATM/ANS) systems and procedures in accordance with the ATM Master Plan, in particular the common projects set up in accordance with Commission Implementing Regulation (EU) No 409/ 2013.

E.2.2 Principles

The Operational Excellence Programme will organise its work based on the provisions laid down in Commission Regulation No 123/2019, Article 9, Network Operations Plan:

"The Network Manager shall establish a detailed Network Operations Plan, in cooperation with operational stakeholders to implement the Network Strategy Plan at operational level in the short and medium term through cooperative decision-making. The Network Operations Plan shall include, in particular:

- *operational actions that contribute to the achievement of the Union-wide performance targets and local performance targets in the performance scheme covering the calendar years of the reference period and the annual, seasonal, weekly and daily periods considering the latest traffic forecast and its evolution.*

- *The Network Operations Plan shall encompass operational actions concerning all network functions and military requirements, if these requirements are provided by Members States. Those operational actions shall be determined through cooperative decision-making and their mutual consistency shall be assessed by the Network Manager.*

- *If the Network Manager identifies operational constraints and bottlenecks preventing achievement of the Union-wide and local performance targets, it shall suggest additional operational actions. Such actions shall be determined through cooperative decision-making.*

- *Air navigation service providers and airport operators shall ensure that their plans are aligned with the Network Operations Plan and implement the operational actions included in the Network Operations Plan."*

E.2.3 Criteria and assumptions

The Operational Excellence Programme will work on the basis of the following criteria and assumptions:

(a) Implementation of an optimised sectorisation ECAC-wide;

(b) In order to avoid frequent operational changes, utilisation of a high traffic forecast to ensure the delivery of a future-proof long-term performance;

(c) Capacity and environment/flight efficiency performance;

(d) For design and operations, European airspace as a single airspace;

(e) Addressing lower and upper airspace, with appropriate connectivity with the TMAs;

(f) Ensuring TMA connectivity (including TMAs covering several airports) and CCO/CDO operations, re-organisation of airspace above FL410, re-consideration (if necessary and in cooperation with all operational stakeholders), of the airspace classification (on the basis of the ICAO classification), gradual integration of new entrants, etc.

(g) Further progressing with the harmonisation of Advanced Flexible Use of Airspace procedures. This should include the promotion of the utilisation by General Air Traffic of available / released "Special use airspace" (Civil Use of Released Airspace) in order to fully reap the benefits of the FUA concept;

(h) Accommodate operational needs of airspace users to the largest possible extent;

(i) Ensure early alignment and close cooperation with the Computer Flight Planning Service Providers (CFPS)

(j) Stepped implementation over RP3 in parallel with the implementation of the optimised sectorisation.

The topics potentially to be covered are: changes of operational procedures, Letters of Agreement, application of A-FUA and ATFCM, operational utilisation of resources, harmonised implementation of new operational concepts and technologies, smaller adaptations to systems, etc. The formal and detailed scope of the topics to be covered will be decided jointly and collaboratively by all operational stakeholders, as part of the project launch.

E.2.4 Role

Within the framework provided by the SES regulations, the Operational Excellence Programme will ensure the co-ordination for the implementation of best practices and enhanced operational and technical concepts, potentially covering: changes of operational procedures, letters of Agreement, application of A-FUA and ATFCM, flight notification and coordination exchanges, operational utilisation of resources, harmonised implementation of new operational concepts and technologies, smaller adaptations to systems, systems connectivity and interoperability, reasons for different levels of sectors throughput, etc. The Operational Excellence Programme will carry out its work within an enhanced Network Operations Plan CDM Processes in cooperation with all operational stakeholders.

The Operational Excellence Programme shall:

a) Ensure the further identification and consolidation of the topics to be included in its area of responsibility;

b) Cover all aspects related to the topics listed above;

c) Ensure the development and consolidation at local and network level of short, medium and long term operational development and implementation plans over the period 2020-2025;

d) Ensure the availability of quick wins for implementation as from Summer 2020;

e) Ensure the collection and consolidation of all requirements and best practices for the short, medium and long term;

f) Identify operational and technical bottlenecks and the mitigation solutions thereto

g) .

E.2.5 Composition

The participants in the Operational Excellence Programme shall be civil and military experts, operational experts from ECAC member States and their ANS providers, as well as civil airspace users and airport representatives. The membership shall be constituted by the participants in the Network Operations Plan Network CDM Processes. Appropriate cooperation will be secured with the SESAR Deployment Manager within the remit of its responsibilities.

E.2.6 Operational Excellence Programme completion criteria

Consistent implementation of the topics identified by the programme by all the concerned operational stakeholders. Monitoring will be executed through the enhanced Network Operations Plan CDM Processes in cooperation with all operational stakeholders.

Appendix F Link to SESAR Solutions delivery

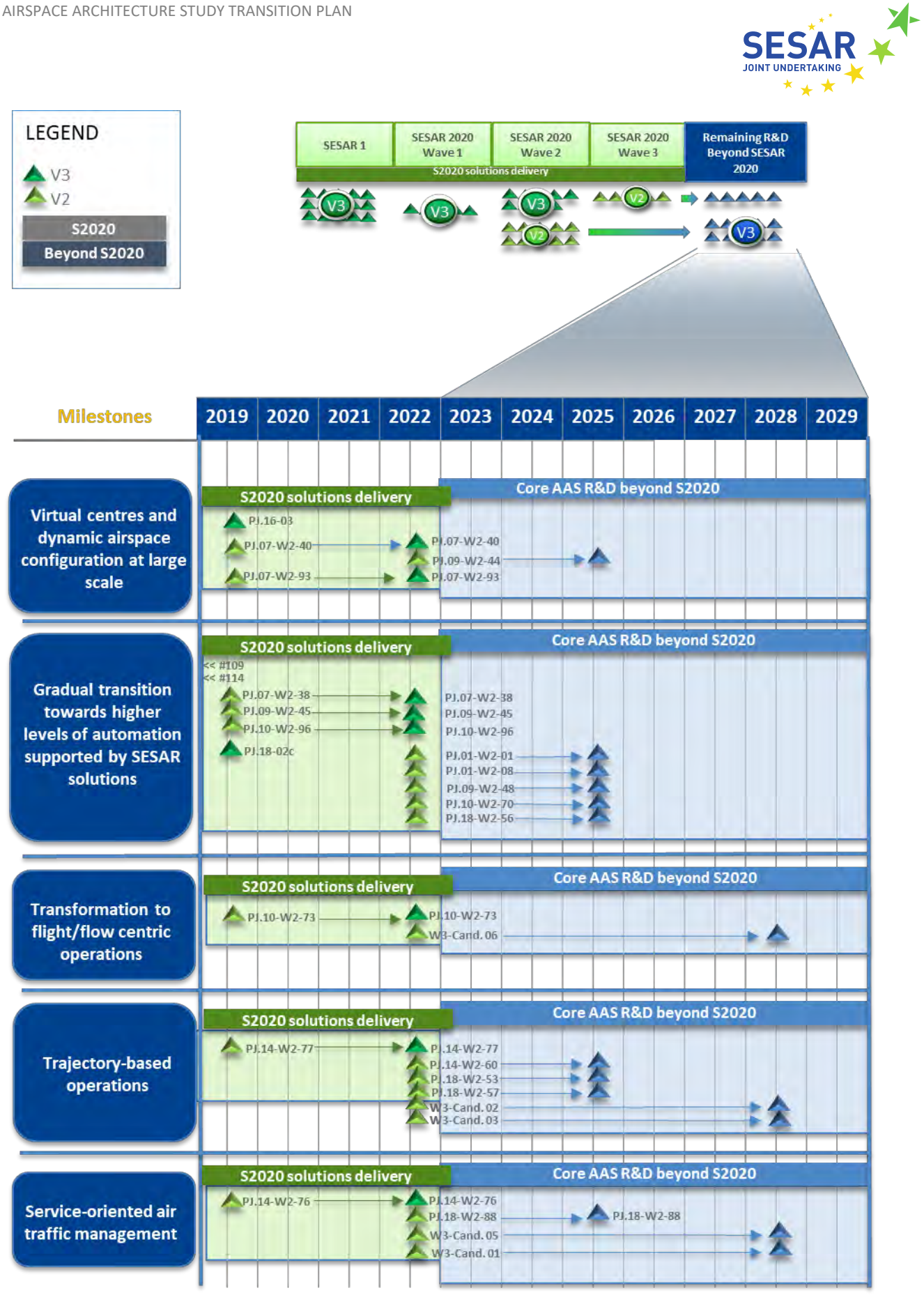
F.1 Overview for core R&D in relation to the AAS

The core R&D that underpins the study is fully covered by the SESAR programme. In accordance with the AAS Appendix E, a gap analysis has been performed to assess the degree of coverage of the scope of the solutions listed in the AAS Appendix E against the outcome of the evaluations of the SESAR Wave 2 call and the updated information available at the time of writing this plan on the progress of the R&D activities in Wave 1:

- Fifteen solutions were already V3 mature at the end of SESAR 1.
- Fourteen solutions are expected to be V3 mature at the end of SESAR 2020 (five in Wave 1 and nine in Wave 2).
- Ten Wave 2 solutions are expected to reach V2 maturity at the end of SESAR 2020, and will need further validation beyond 2022 to reach V3; and
- Five solutions have been defined to cover the content that is not addressed in the Wave 2 grants, and are currently in candidate status for the Wave 3 call specification. They will also reach V3 maturity beyond 2020.

Details of this snapshot[19], including the detailed list of solutions, their planned maturity date and their link to the AAS milestones, are described in this Appendix in relation to the AAS Transition Strategy.

[19] For solutions in the R&D phase, this snapshot presents the expected maturity date with the best information that is available to the SJU at the time of writing this document.


LEGEND
V3
V2
S2020
Beyond S2020
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SESAR 2020 Wave 1
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Remaining R&D Beyond SESAR 2020
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2019
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Virtual centres and dynamic airspace configuration at large scale
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Transformation to flight/flow centric operations
Trajectory-based operations
Service-oriented air traffic management
Core AAS R&D beyond S2020
PJ.16-03
PJ.07-W2-40
PJ.07-W2-93
PJ.09-W2-44
<< #109
<< #114
PJ.09-W2-45
PJ.10-W2-96
PJ.18-02c
PJ.01-W2-01
PJ.01-W2-08
PJ.09-W2-48
PJ.10-W2-70
PJ.18-W2-56
PJ.10-W2-73
W3-Cand. 06
PJ.14-W2-77
PJ.14-W2-60
PJ.18-W2-53
PJ.18-W2-57
W3-Cand. 02
W3-Cand. 03
PJ.14-W2-76
PJ.18-W2-88
W3-Cand. 05
W3-Cand. 01

F.2 Milestone 1: ECAC-wide implementation of cross-border Free Route, air ground and ground-ground connectivity

In Milestone 1, the implementation of two foundational technical enablers is essential in order to pave the way for the implementation of the revolutionary changes planned from Milestone 3 onwards:

- Initial implementation of the first two air-ground data exchange technical solutions (solution #115, solution #18-06a) is an essential foundation for the increase in the level of automation of the ATM systems that is planned from Milestone 3 onwards.
- Ground-ground interoperability (solution PJ.18-02b) and data exchange (Solution #46, solution PJ.17-W2-101) are critical to defragment the technical dimension of ATM, an essential foundation to move to the ATM data service provision in a virtual centre context planned from Milestone 3 onwards.

Ground-ground interoperability make it possible to extend arrival management beyond national borders (solution #05), improving the delivery of traffic to the busiest European airports.

The implementation of cross-border and cross-FIR free route airspace (solution #32, solution PJ.06-01) provides maximum benefit when combined with the more efficient Airspace Management concepts enabled by advanced Flexible Use of Airspace (solution #31). Improved tactical controller tools (solution #27) provide improvements to the automation support to controllers, increasing safety and ATC capacity.

All the solutions supporting Milestone 1 are part of the PCP except solutions #27 and PJ.17-W2-101.

Solution id	Title	Description	V3 Date
#32	Free Route through the use of Direct Routing	Direct routing is established within direct routing airspace with the aim of providing airspace users additional flight planning route options on a larger scale across FIRs such that overall planned leg distances are reduced in comparison with the fixed route network and are fully optimised. Direct Routing Airspace defined laterally and vertically with a set of entry/exit conditions where published direct routings are available. A Direct Routing is a published segment of a great circle between 2 published waypoints.	2016 (SESAR 1)
#46	SWIM Yellow Profile	To foster interoperability within the future European ATM Network (EATMN) as envisaged by SWIM, the SESAR programme developed a series of documents covering aspects such as concepts, service descriptions, templates, governance and a series of technical resources such as models. The SWIM Technological solution provides a coherent set of specifications providing essential requirements that are	2016 (SESAR 1)

		applicable to the standards used in the context of SWIM implementation. These documents are seen as the key elements in steering SWIM enabled systems for ensuring the interoperability; AIRM; Semantic interoperability | ISRM: 3.1 Organisational interoperability | SWIM TAD, profiles, SWIM TI; SWIM Technical Infrastructure (SWIM TI) and architecture shall enable technical interoperability | The SWIM registry aims at improving the visibility and accessibility of ATM information and services available through SWIM. It enables service providers, consumers, and the swim governance to share a common view on SWIM. The SWIM registry provides consolidated information on services that have been implemented based on SWIM standards. Registry Technical Specification and Registry Concept of Operation documents provides information and requirements required for the implementation of SWIM registry	
#115	Extended Projected Profile (EPP) availability on ground	Trajectory management is a key cornerstone of the ATM system. The better the trajectory prediction is, the better the whole ATM system will be. Nowadays there are multiple trajectory predictions held and maintained by air and ground actors. They take into account different parameters (e.g. aircraft model, route/ restrictions, operating preferences & weather forecast) leading to inconsistencies and different accuracy levels depending on flight phases. These inconsistencies lead to an inefficient ATM system as a whole. "EPP availability on ground" technological solution is a first step towards a full ground-air trajectory synchronisation required for the implementation of the targeted Trajectory based operations. It allows the provision to the ground systems of the aircraft view on the planned route and applicable restrictions known to the airborne system, together with the corresponding optimal planned trajectory computed on-board and speed preferences. This information is automatically downlinked from the airborne Flight Management System via ADS-C data link to the ground ATC unit which has subscribed to the needed service contract (e.g. Extended Projected	2016 (SESAR 1)

		Profile & Speed Schedule Profile contracts) and made available to the controllers	
#27	Enhanced tactical conflict detection & resolution (CD&R) services and conformance monitoring tools for en-route	This SESAR Solution consists of innovative approaches that provide the en-route controller with two separation provision services: First, an enhanced monitoring conformance service (MONA) for both tactical and planning controllers. Compared to the existing MONA, this SESAR Solution includes a new alert to take into account lateral deviation and the rate change monitoring in climbing and descending phase to minimise false alerts. Second, a conflict detection and resolution service fully dedicated and designed for the tactical controller with a conflict detection service down to flight level 100. This service is based on effective clearances and specific ergonomics and use developed for the tactical controller, but also available and usable for the planning controller	2016 (SESAR 1)
#33	Free Route through Free Routing for Flights both in cruise and vertically evolving above a specified Flight Level	A User Defined Segment is a segment of great circle connecting any combination of two user defined or published waypoints. Free Routing Airspace is an airspace defined laterally and vertically, allowing Free route with a set of entry/exit features. Within this airspace, flights remain subject to air traffic control.	2016 (SESAR 1)
PJ.06-01	Optimized traffic management to enable Free Routing in high and very high complexity environments.	Optimised traffic management to enable Free Routing in high and very high complexity environments sees airspace users being able to plan flight trajectories without reference to a fixed route network or published directs within high and very high-complexity environments so they can optimise their associated flights in line with their individual operator business needs or military requirements. The solution provides a description of high and very high complexity cross-border Free Routing environment in upper airspace (at the 2022 timeframe - as per PCP AF#3). The scope of the solution focuses on the improvement of Aircraft-to Aircraft Separation Provision to enable Free Routing operations in upper airspace in high and very high complexity cross-border environments (with minimum	2019 (S2020 W1)

		structural limits to manage airspace and demand complexity).	
PJ.18-02b	Flight object interoperability	"The IOP activities include the definition of the IOP Solution, based on the SESAR 1 Solution #28. The IOP scope has been divided into a basic scope, sufficient to deploy IOP in the core area of Europe, and the Full scope, which provides additional IOP functionalities	2020 (S2020 W1)
#31	Variable profile military reserved areas and enhanced (further automated) civil-military collaboration	Variable profile military reserved areas and enhanced (further automated) civil-military collaboration.	2016 (SESAR 1)
#18-06a	Air Traffic Control (ATC) Planned Trajectory Performance Improvement	The solution enhances the predictability of the network by incorporating the consideration of the eFPL in the trajectory prediction.	2019 (S2020 W1)
#05	Extended Arrival Management (AMAN) horizon	Operational procedures and technical specifications for the integration of the information from arrival management systems operating out to an extended distance to provide an enhanced and more consistent arrival sequence. The system helps to reduce holding by absorbing some of the queuing time further upstream well into En Route. Includes integration of traffic departing from within the AMAN horizon of the destination airport. In Step 1, the 'newly' impacted En Route sectors are expected to contribute to the sequencing towards a single TMA	2015 (SESAR 1)
Solution PJ.17-W2-101	SWIM TI Green profile for G/G Civil Military Information Sharing	The solution aims at enabling Ground/Ground civil – military SWIM based coordination at SWIM technical infrastructure level through SWIM profiles with an adequate quality of service, including (cyber) security/ resilience, needed by military stakeholders and agreed by civil stakeholders.	2022 (S2020 W2)

F.3 Milestone 2: Launch airspace re-configuration supported by Operational Excellence Programme

The PCP AF4 (solutions #17, #18, #19, #20, #21, #37, #66) is already implemented, boosting network performance. A collaborative process involving all operational stakeholders (NM, ANSPs, Airports and AUs) has been set-up to enable airspace to be reconfigured irrespective of national borders on a periodic basis (typically seasonally) to best accommodate ECAC traffic flows.

An operational excellence programme is launched in order to identify best practices and capture quick wins (through small changes in operational procedures, smaller adaptations to systems, etc.) among all stakeholders and effectively support their implementation to reduce delays.

Solution id	Title	Description	V3 Date
#66	Automated Support for Dynamic Sectorisation	Automated support for Dynamic Sectorisation provides supporting tools to areas with high traffic density to evaluate the most suitable Air Traffic Control airspace configuration (sectors). Dynamic Capacity Management allows adapting the capacity to traffic load by grouping and de-grouping sectors and managing the staff resources accordingly. Unused latent capacity can occur at all Flow Management Positions (FMP) during peak traffic times. Current tools facilitate the detection of overload but do not offer better options to deal with it.	2013 (SESAR 1)
#17	Advanced short ATFCM measures (STAM)	Advanced Short ATFCM measures (STAM) supported by automated tools for hot spot detection at network level enabling ANSPs to optimise traffic throughput. Advanced STAM are built on the basis of STAM implementation (hotspot, coordination tool, occupancy traffic monitoring values). The enhancements foreseen focus on improved predictability of operations, including sib/iRBT supported traffic and complexity prediction, weather, airport operations (departure sequences, ground handling, gate management, runway usage), what-if function and network capabilities.	2016 (SESAR 1)
#20	Collaborative NOP	A Collaborative NOP Information structure (information model, classification by types of actions, influencers, performance objectives, relationships between actions, objectives, issues, etc.) will be available. The Collaborative NOP will	2016 (SESAR 1)

		be updated through data exchanges between Network Manager and stakeholders systems to the required level of service. This will enable the Network Manager and stakeholders to prepare and share operational decisions (e.g. TTA, STAM) and their justifications in real-time.	
#18	CTOT and TTA	Transition from calculated take off time (CTOT) to CTOT & target time arrival (TTA) Consideration of TTA at Network Manager level for traffic planning activities (ATFCM measures) and distribution of the TTA through NOP in particular to the airport of destination.	2016 (SESAR 1)
#19	Automated support for Traffic Complexity Detection and Resolution	Automated tools support the ATC team in identifying, assessing and resolving local complexity situations. It relies on a real time integrated process for managing the complexity of the traffic with capability to reduce traffic peaks through early implementation of measures for workload balancing Traffic Complexity Assessment and Individual Traffic Complexity based solutions	2016 (SESAR 1)
#37	Extended Flight Plan	The extended flight plan is an extension of the ICAO 2012 FPL. New information encompasses: - The 4D trajectory as calculated by the FOC flight planning system in support to the generation of the operational flight plan. The 4D trajectory information in not limited to 4D points. It contains additional elements for each point of the trajectory such at speeds, and aircraft mass; - Flight specific performance data: the climbing and descending capabilities of the aircraft specific to the flight. Short term use cases for EFPL are: The solution develops the concept and the use of the extended flight plan to improve the process of validation of flight plans by the Network Manager, in particular by reducing the number of flight plan rejections resulting from the low resolution of the ICAO 2012 flight plan.	2016 (SESAR 1)

F.4 Milestone 3: Virtual centres and dynamic airspace management at large scale

In the technical domain, solution PJ.16-03 already provides in wave 1 a solution in to technically support the decoupling of FDPS services and the CWP though the virtual centre concept, enabling initial consolidation of services for increased cost efficiency. Consolidation of FDPS services starts within ANSP industrial partnerships that use the same ground system providers, and is gradually extended by the creation of competitive providers of FDPS services that ANSPs contract their services from.

In the operational domain, solution PJ.10-W2-93 covers the operational aspects related to the delegation of airspace and contingency, increasing the resilience of the ATM system and enabling increased ATC capacity though the capacity-on-demand service and through the release of ATCO hours at valley hours enabled by the consolidation of ATC facilities at periods of low demand (e.g. nights).

A Wave 3 candidate solution (W3-C01) has been defined to develop system support with the objective of increasing the average number of sectors/configurations that a controller can be endorsed for. This increased flexibility facilitates the allocation of controllers to where there is traffic demand within a single ANSP and across ANSPs (though the capacity-on-demand concept), as well as the consolidation of ATC facilities during periods of low demand.

Building on the PCP functionalities implemented in Milestone 2, Innovation in airspace management continues to increase efficiency though the introduction of dynamic airspace configurations (solution PJ.07-W2-44) combined with improved civil-military coordination though the management of mission trajectories integrated with DMA types 1 and 2 allows (solution PJ.07-W2-40).

Solution id	Title	Description	V3 Date
PJ.16-03	Work Station, Service Interface Definition & Virtual Centre Concept	Work Station, Service Interface Definition & Virtual Centre Concept will provide an operating environment in which different ATS units, even across different ANSPs, will appear as a single unit and will be subject to operational and technical interoperability. It includes the develop the ATSU architecture from a service oriented approach with a focus on the technical services and common interfaces. Based on the Virtual Centre concept, the CWP/HMI needs to interface with one or more information service providers or consumers. A high performing and reliable underlying communication infrastructure may be needed. This solution encompasses En-route and TMA and airport/TWR environments.	2019 (S2020 W1)
PJ.07-W2-40	Mission trajectories management with integrated Dynamic	The objective of the solution is to improve the use of airspace capacity for both civil and military users and the efficiency of airspace management by introducing more automation and increased	2022 (S2020 W2)

	Mobile Areas Type 1 and Type 2	flexibility in the civil-military coordination. The solution delivers improvements to the planning phase of the mission trajectory, including the connection of MT management with the booking of ARES (in the context of this solution DMA Type 1 and Type 2), for which the WOC will be the key actor. The coordination between WOC and regional NM is a key element for this solution.	
PJ.09-W2-44	Dynamic Airspace Configurations (DAC)	The objective of the solution is to improve the use of airspace capacity for both civil and military users by increasing the granularity and the flexibility in the airspace configuration and management within and across ANSPs' areas of responsibilities. This solution will address the integration of concepts and procedures to allow flexible sectorisation boundaries to be dynamically modified based on demand. This includes potential implications for ATCO licences, international boundaries and potentially IOP and A/G multi-datalink communication capabilities.	Post-S2020
PJ.10-W2-93	Delegation of airspace amongst ATSUs	The objective of this solution is to explore the different possible delegation of airspace amongst ATSUs based on traffic / organisation needs (either static on fix-time transfer schedule (Day/Night) or dynamic e.g. when the traffic density is below/over certain level) or on contingency needs. The solution covers an operational thread, which aims at defining and validating the different types of delegation of airspace and a technical thread, which aims at specifying the impacts of the operational thread on the services defined in the Virtual centre concept.	2022 (S2020 W2)

F.5 Milestone 4: Gradual transition towards higher levels of automation supported by SESAR Solutions

These solutions cover the required automation support to enable an efficient transition between en-route and the extended TMA (PJ.01-W2-08), to improve the performance of the network (PJ.18-02c, PJ.07-W2-38, PJ.09-W2-45, PJ.09-W2-48, PJ.09-W2-45) and ATCO support tools to increase the airspace capacity (PJ.10-W2-70, PJ.10-W2-96, PJ.18-W2-56).

In the CNS domain, the IRIS precursor provides additional data link capabilities to enable the increased air/ground data exchange (solution #109), and ADS-B/WAM cooperative surveillance is implemented (solution #114), in particular in support of the increased resilience of the surveillance service.

Implementation of the increased automation support should not need incentivisation (because it increases the productivity of ANSPs, it is expected to have a positive business case, and therefore not need incentivisation). This applies also to the implementation on the ground of the IRIS precursor; on the airborne side, the IRIS precursor solution may need incentivisation. Incentivisation for the implementation of Solution #114 may be necessary.

Solution id	Title	Description	V3 Date
#109	Air traffic services (ATS) datalink using Iris Precursor	The Iris Precursor offers a viable option for air traffic services (ATS) datalink using existing satellite technology systems to support initial four-dimensional (i4D) datalink capability. The technology can be used to provide end-to-end air-ground communications for i4D operations, connecting aircraft and air traffic management ground systems.	2016 (SESAR 1)
#114	Cooperative Surveillance ADS-B / WAM	Air traffic surveillance systems use both cooperative and non-cooperative techniques to locate aircraft. While non-cooperative techniques rely on the reflection of energy directed at the aircraft, cooperative techniques require the carriage of a transponder or transmitter device on board the aircraft. Systems using the signals broadcast from such transponders / transmitters are classified as a cooperative independent technology, as the ground surveillance systems derive all surveillance information from the decoded message content to determine aircraft identity and 3D position. Systems, such as ADS-B, in which the aircraft transmits its own position are classified as a cooperative dependent technology.	2016 (SESAR 1)
PJ.18-02c	eFPL supporting SBT transition to RBT	This Technological Solution will look at the distribution of eFPL information to ATC systems, and at the possible improvements of the alignment of AUs' and NM's trajectories especially concerning use of PTR s and Standard Instrument Departure (SID)/Standard Arrival Route (STAR) allocation.	2019 (S2020 Wave 1)
PJ.01-W2-01	Next generation AMAN for 4D environment	This solution will provide enhancements to the arrival management systems and procedures in the context of digitalisation in ATM: uplink of AMAN constraints, uplink of a STAR or custom arrival route to the aircraft via ATN B2 from the ATSU, potential use of maximum descent speeds,	Post-S2020

		etc. It investigates strategies to increase the use of managed/automatic mode for flights handled by TTL/TTG during sequencing, improved consideration of downlinked aircraft data by AMAN algorithms, use of machine learning for the refinement of AMAN algorithms, etc.	
PJ.01-W2-08	Dynamic E-TMA for Advanced Continuous Climb and Descent Operations and improved Arrival and Departure Operations	The objective of this solution is to improve descent and climb profiles in busy airspace, as well as the horizontal flight efficiency of arrivals and departures, while at the same time ensuring traffic synchronisation, short-term DCB and separation. This requires a very broad scope, which includes advances in airspace design, development of ground tools, and development of ATC and airborne procedures.	Post-S2020
PJ.07-W2-38	Enhanced integration of AU trajectory definition and network management processes	The objective of this solution is to reduce the impact of ATM planning on Airspace Users' costs of operations, by providing them a better access to ATM resource management and allowing them to better cope with ATM constraints. The solution shall improve Airspace Users flight planning and network management through improved FOC participation into the ATM network collaborative processes in the context of FF-ICE and its potential evolutions.	2022 (S2020 W2)
PJ.09-W2-45	Enhanced Network Traffic Prediction and shared complexity representation	The solution aims at improving the accuracy of the network manager traffic prediction from medium-term planning phase (D-2) to execution (included), relying in particular on new trajectory management features such as the preliminary FPL. It shall adapt existing methodologies and algorithms for demand prediction and regional complexity assessment.	2022 (S2020 W2)
PJ.09-W2-48	Digital Integrated Network Management and ATC Planning (INAP)	The SESAR solution 'digital INAP' aims at filling the gap between the management of traffic flows at network level (dDCB) and the control of flights in individual sectors. The solution develops and integrates local functions and associated tools, roles and responsibilities providing an automated interface between local NM and ATC planning to assist controllers in alleviating traffic complexity, traffic density, and traffic flow problems.	Post-S2020
PJ.10-W2-70	Collaborative control and Multi sector	The solution addresses the collaborative control with unplanned boundaries concept, in which the	Post-S2020

	planner (MSP) in en-route	traditional requirement to coordinate traffic at all sector boundaries is waived for an area covering two or more sectors. In case it is not completed in wave 1, the solution scope covers as well the development, for the en-route environment, of the concept of operation and the required system support e.g. coordination tools for operating in a team structure where a Planner has responsibility for the airspace under the executive control of two or more independent Executive Controllers (multi-sector planner or MSP). The MSP is able to adjust the internal (executive) sector boundaries so that workload is balanced between the Executive controllers.	
PJ.10-W2-96	HMI Interaction modes for ATC centre	The solution addresses the development of new human machine interface (HMI) interaction modes and technologies in order to minimise the load and mental strain on controllers in the ATC centre. The SESAR solution shall consider modern design and development approaches and methodologies such as modularity, SoA, adaptive automation, etc. The new HMI interaction modes include the use of in-air gestures, attention control, user profile management systems, tracking labels, virtual and augmented reality, etc.	2022 (S2020 W2)
PJ.18-W2-56	Improved vertical profiles through enhanced vertical clearances	The objective of this solution is to develop an automation support for ATCOs to issue vertical constraints that support more efficient flight profiles while ensuring separation provision. First step, for flight still in climb, enhanced prediction of vertical profile data are presented to ATCOs to facilitate decision making. In a second more advanced step, the ATC system would generate proposals for conflict-free clearances that take anticipated aircraft performance into account, which can be uplinked to the flight crew by ATCO.	Post-S2020

F.6 Milestone 5: Transformation to flight/flow centric operations

For this milestone, the initial implementation of the flight centric concept as validated in Wave 2 is planned (PJ.10-W2-73). The Wave 1 results suggest that the concept will provide value in low and medium density en-route environments. In some cases a flight centric area can be larger than the coverage of a single VHF frequency; is made possible by the Wide Area Communication concept, included in the solution.

The (PJ.10-W2-73 flight-centric concept requires one frequency per ATCO, which considering that there are no planners in flight-centric means that the concept requires more frequencies than sectored ATC. The frequency sharing concept included in the follow-up solution Enhanced Flight-Centric Operations (W3-C06) will mitigate this issue, as well as allow the introduction of the capacity-on-demand service in a flight-centric environment through the innovative flight-centric distributed team (delegation of workforce instead of delegation of airspace).

Solution id	Title	Description	V3 Date
PJ.10-W2-73	Flight-centric ATC and Improved Distribution of Separation Responsibility in ATC	The solution covers a concept that consists of assigning aircraft to ATCOs without references to geographical sectors, and have the aircraft controlled by that same ATCO across two or more geographical sectors. The solution requires flight-centric specific allocation, visualisation (traffic filtering), coordination tools (e.g. in the event of a conflict, establish which controller is responsible for its resolution) and, for high traffic densities advanced CD&R tools (that are not flight-centric specific). The solution also covers the concept of collaborative control with planned boundaries in which sectors are retained as they are today, with aircraft being assigned to a sector according to its geographic location. The boundaries between sectors have planned coordination conditions like in current operations, but with some additional flexibility by allowing controllers to issue clearances without prior coordination to aircraft in a different sector.	2022 (S2020 W2)
W3-Candidate 06	Enhanced Flight-Centric Operations	The Wave 3 solution includes improvements beyond the Wave 2 flight-centric solution, including in particular the distributed flight-centric team, the share-frequency concept and the flight-centric solution in challenging high-density/high-complexity environments.	Post-S2020

F.7 Milestone 6: Trajectory Based Operations (TBO)

TBO is central to ICAO and SESAR's vision for efficient and safe ATM operations based on the optimised, accurate and constantly updated trajectory. It includes a list of enablers (PJ.14-W2-60, PJ.14-W2-77) in support of new air/ground information sharing processes (W3-C03 and W3-C02). Innovative controller tools in support of the TBO concept will be rolled out (PJ.18-W2-53, PJ.18-W2-57).

Solution id	Title	Description	V3 Date
PJ.14-W2-60	FCI Terrestrial Data Link and A-PNT enabler (L-DACS)	The solution constitutes the future terrestrial A/G and A/A data link solution, which is one of the 'ICAO technologies', and supports the increasing ATM performance requirements (due to the growth of air traffic and its complexity). L-DACS constitutes a potential component of the A-PNT to support positioning and navigation requirements in PBN/RNP operations in case of a GNSS degradation or outage.	Post-S2020
PJ.14-W2-77	FCI Services	The Solution will allow the real-time sharing of trajectories, timely access to ATM data and information services and the support to SWIM. The 'Communication Services' will support ATN-B1, ATN-B2 ATS services, and be expandable to support advanced ATM applications such as ATN-B3 ATS services. It will support AOC services and digital voice (VoIP) services. The Communication Services will be delivered using ATN/IPS and will allow interoperability with ATN/OSI protocols.	2022 (S2020 W2)
PJ.18-W2-53	Improved Ground Trajectory Predictions enabling future automation tools	The solution focuses on the operational validation of improved CD&R tools. The main goal is to increase the quality of separation management services reducing controller workload and separation buffers and facilitating new controller team organisations. The foundation is the improvement of the ground TP (EPP data beyond weight and CAS, known MET data or new MET data and capabilities, etc.).	Post-S2020
PJ.18-W2-57	RBT revision supported by datalink and increased automation	The solution aims at supporting a continuous increase in the amount and the usefulness of information shared between air and ground and of the level of automation support to controllers and pilots, e.g. towards the automatic uplink of clearances with or without previous controller validation and towards increased use of the auto-load to FMS of uplinked clearances and of managed/automatic mode by the flight crew.	Post-S2020
W3-Candidate 02	Enhanced operations through advanced ATN B3 digital voice and datalink	This solution covers the operational dimension of PJ.14-W2-60, which is working on the technical infrastructure e.g. LDACS. It includes the extension of the use of datalink to the lower airspace and the introduction of the single	Post-S2020

	controller/pilot communications	connection to ATC concept, where voice, datalink and ADS-C handovers will be transparent to the flight-crew.	
W3-Candidate 03	Improved operational efficiency through ATN B3 automatic air/ground data synchronisation	This solution covers the evolution of the automatic air-ground synchronization, as well as the development of the linked ground and airborne procedures and systems. It will dramatically increase the on-board use of managed mode and auto loading of ATC clearances. ATN B3 will include the "single connection the ATC" concept, where voice, datalink and ADS-C handovers will be transparent to the flight-crew.	Post-S2020

F.8 Milestone 7: Service-oriented air traffic management

Full implementation of the decoupling of air traffic services, ATM data services (PJ.18-W2-88), integration services and geographically fixed services will take place in this milestone. This structural change of the European ATM system will increase its flexibility and resilience, and allow for scalability. This includes as well the definition of a performance and service based CNS infrastructure (PJ.14-W2-76).

A Wave 3 candidate solution (W3-C01) has been defined to develop system support with the objective of increasing the average number of sectors/configurations that a controller can be endorsed for. This increased flexibility facilitates the allocation of ATCO resources across the network, thereby supporting the capacity-on-demand service.

The digital voice service (W-C05) will prevent the lack of availability of VHF frequencies to stop traffic growth, and support of the digitalisation objective. The implementation of digital voice will be smooth thanks to the flexibility made possible by flight-centric operations (milestone 5), which makes it possible that equipped and non-equipped aircraft be able to fly in the same airspace during the transition phase.

Solution id	Title	Description	V3 Date
Solution PJ.14-W2-76	Integrated CNS and Spectrum	The solution addresses the CNS cross-domains consistency in terms of robustness, spectrum use and interoperability including the civil-military aspects through the provision of a global view of the future communications, navigation and surveillance services and the definition of the future integrated CNS architecture (and the CNS spectrum strategy).	2022 (S2020 W2)

Solution PJ.18-W2-88	Trajectory Prediction Service	This solution is a technical service conceived as being provided to Europeans ANSPs, AUs, AO, Military and the Network Manager (NM) in support of trajectory operations. The solution is intended to provide a single point of truth for a specific trajectory in the time frame from creation in long term pre-flight planning through to the flight execution phase. The solution is not intended to replace today's flight data processing systems and consequently the service can be used as an input to ATC systems but not used directly for control purposes.	Post-S2020
W3-Candidate 05	L-DACS Voice and common digital information distribution mechanisms	This solution supports ATN B3. It includes the geographically independent controller-pilot digital voice communication service, as well the development of the architecture for routing the distribution of information (be it voice or data) from originator to recipient.	Post-S2020
W3-Candidate 01	Sector independent controller validations	This solution makes it possible to reduce the number of hours required for a controller to maintain the endorsement to work in a sector or flight-centric area, thereby making it possible that he or she be endorsed for more sectors than today, thereby increasing the flexibility in the allocation of controller resources, and allowing a wider implementation of the capacity-on-demand service.	Post-S2020

F.9 R&D complementary to the AAS

The AAS study has been limited in scope to focus on the upper airspace only. As such is cannot replace the European ATM masterplan, which is still leading. Consequently, the AAS architecture remains embedded in a bigger evolution on Air Traffic Management:

- With the overall increase of air traffic, congestion at airports and their corresponding terminal airspace will increase. Future R&D will aim to increase airport and TMA capacity.

- Remotely piloted aircraft systems (RPAS) will be integrated into the ATM environment. Research is need to define and validate the mechanisms for RPAS collision avoidance and effective situational awareness of the remote pilot. The objective is to enable IFR RPAS operating from dedicated airfields to routinely operate in airspace classes A to C as general air traffic (GAT) without a chase plane escort. This requires the development of ATC procedures, adaptations to the flight planning processes, contingency etc. Technical capabilities and procedural are required to allow IFR RPAS to comply with ATC instructions. New procedures

and tools are required to allow ATC to handle IFR RPAS in a cooperative environment in full integration with manned aviation.

- New Entrants represent an increasing body of actors who are seeking to implement new aviation concepts in airspace where there is currently little managed activity. The scope covers U-space to manage drones, typically in airspace below 500 feet, including over cities, and Higher Airspace Operations, in airspace above levels used by existing airspace users, typically above FL660. These actors are often new to aviation and use or intend to use new technologies and air vehicle concepts, experimental prototypes, or sometimes aircraft still in the R&D phase (e.g. supersonic or hyper-sonic projects), manned and unmanned, for which there is currently little or no regulation, standardisation or certification requirements in place.

- The objective of U-space, whose development has already started in SESAR 2020, is to create the building blocks of a system that provides services that are scalable for large numbers of small drones, creating an ecosystem that is very different from ATM to meet all drone specific requirements, but that is nevertheless seamlessly integrated with ATM.

- There is a need to guarantee that the implementation of the AAS vision is not at the expense of equity and access for emerging demand like New Entrants, U-space and IFR RPAS, as well as any future evolution in the demand of General Aviation (GA) and Rotorcraft.

- New technologies will arise, complying with the CNS performance based approach as defined in the AAS. Building on the success of EGNOS and IRIS, this may include, but is not certainly not limited to, the further extension of performance based satellite based services.

- Progress made in the field of machine learning and artificial intelligence will open the door to a multitude of innovative applications in ATM. Tasks will be performed collaboratively by hybrid human-machine teams, where advanced adaptable and adaptive automation principles could dynamically guide the allocation of tasks.

- New environmental solutions may be researched and developed to target a reduction in noise and/or fuel burn. Potential research may target green taxi operations and formation flying for civil aviation, and also at controller tools targeting specific environmental improvements.

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