Guidance Material for SESAR Deployment Programme Implementation

Planning View 2019

Proposal for Update
to European Commission

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Introduction

The adoption by European Commission of the Reg. (EU) n. 716/2014 (Pilot Common Project), the establishment of the SESAR deployment Manager as per Reg. (EU) n. 409/2013, as well as the subsequent elaboration of the SESAR Deployment Programme, marked the real start of the Deployment Phase of the SESAR Project. It is within this phase that the modernization of the European ATM system becomes an operational reality and brings expected benefits, after its careful planning and its progress towards an adequate level of technological maturity.

This modernization initiative entails a coordinated effort from all operational stakeholders impacted by the Regulation, which are required to get organized to ensure a synchronized, timely and performance-driven deployment of the ATM Functionalities included in the PCP.

In this framework, whereas the Pilot Common Project sets out, at very high level, what has to be implemented, where it should be implemented, which stakeholders are called to invest to implement, and when this implementation shall be completed, the SESAR Deployment Programme represents the necessary planning tool and common reference work plan to steer the implementation and detail how the deployment activities should be carried out.

As the Single European Sky environment is under constant evolution and the European ATM infrastructure is expected to experience further developments and transformation, the tailored structure of the SESAR Deployment Programme has been designed in order to allow an adequate level of flexibility, and to ensure constant alignment with the living ATM scenario.

Figure 1 - The SESAR Deployment Programme and its Guidance Material

The Planning View 2019 thus represents the further breakdown and update of the "*Project View*" of the Pilot Common Project, as laid down within the SESAR Deployment Programme.

The Planning View is updated on a yearly basis to make sure that all operational stakeholders can adapt their investment plans and their implementation activities on the basis of the latest strategic developments.

In a nutshell, the Planning View provides a more detailed planning tool to Operational Stakeholders involved in the deployment of PCP Regulation, clearly defining the scope of the implementation activities, as well as the suggested approach to be followed.

In addition, this document represents the technical and most up-to-date reference for the submission of projects under upcoming CEF Calls, within the SESAR Priority, in the Category Common Projects. The document aims also at providing common guidelines for those operational Stakeholders willing to deploy some parts of the PCP without CEF funds.

Considering its role as blueprint for ATM Stakeholders' investment plans, the Planning View is therefore organized into the following four sections:

- Section 1 provides an overview of the new SESAR trends;
- Section 2 summarizes the main strategic elements that need to be addressed to ensure a timely and synchronized deployment of the PCP. The section presents an outlook on some of the key deployment activity streams, such as the Implementation of Data Link capabilities, the establishment of the SWIM Governance framework, a specific section on the cyber security aspects, and a specific focus on Global Interoperability;
- Section 3, which outlines, as a refinement of the "*Short-Term Deployment Approach*" described in the SESAR Deployment Programme, the approach to be followed in the short-to-medium term, highlighting those activities that are most urgently needed, as well as indications on the typical duration of their implementation. The analysis will be based on the optimization and / or sequencing aspects of the implementation activities, as well as on performance and CBA-related considerations.

- Section 4 lays down and further specifies the scope, features and main attributes of the 48 families identified in the SESAR Deployment Programme. The Family-based tables comprise all relevant information associated to the technological and operational elements to be deployed, complemented by specific recommendations to Stakeholders involved in their implementation, together with an overview of key activities to be performed and milestones to be achieved (i.e. the so-called *deployment approach* at family level)[1].

The updated Planning View 2019 also encompasses two separated Annexes:

- Annex A: Project View – Project Details, which features additional details on the 2014, 2015, 2016 and 2017 CEF-awarded projects. Due to its large size, this Annex will be available only on electronic version on the SESAR Deployment Manager website;

- Annex B: Standardization and Regulation Roadmaps, updated with the ultimate goal of becoming the bridge between the SESAR Development and Deployment Phase through the industrialization phase. For each of the 48 Families of the SDP, the Annex connects them with the relevant SESAR solutions, Very Large-Scale Demonstrations, ATM Master Plan OIs, as well as encompassing the reference to relevant Guidance Material, Specifications, Standards, MoCs and Regulations.

[1] This section will be also matched by a dedicated Appendix – "*List of services covering Reg. (EU) No. 716/2014*" – which contains a list of services partially covering the ATM information exchanges required by the PCP in the framework of the AF5 implementation.

1. New SESAR trends

ATM is in constant evolution. New technologies arise, human role is continuously updated and procedures improved in order to enhance the overall aviation performance. R&D drives these changes and provide the necessary new technologies and operational concepts to modernise ATM systems and operational procedures.

ATM is moving towards digitalisation[2] and, particularly in Europe, towards the need of virtualisation, modularisation and rationalisation to become more cost-effective and enable defragmentation of ANSP service provision. Cybersecurity is also becoming a fundamental aspect of every new digital technology. These new influencing elements are turning priorities in order to reach the SESAR high level goals and the vision described in the ATM Master Plan.

CNS infrastructure and rationalization

All elements of the SESAR concept and therefore parts of the Common Projects, require an efficient supporting infrastructure including Communications, Navigation and Surveillance (CNS) capabilities.

Today, CNS is managed and operated locally, leading to unnecessary multiplicity that has cost, performance and spectrum implications. A holistic approach of technological synergies and architecture would provide significant opportunities for rationalisation and benefits.

As described in the ATM Master Plan, a gradual rationalisation of current CNS infrastructure would lead to network optimisation, following the implementation of new functionalities and/or technologies that support higher performance and efficiency. Decommissioning of legacy systems should happen in parallel when ground-based CNS systems become obsolete as a result of new technologies being deployed and when the operational capability is provided / superseded by the new system. The decision to decommission systems before the end of their design lifetime shall take into consideration the local business case.

As a good practice, when deploying new systems, the local projects should also include a plan for decommissioning the legacy systems through which the same functionality was previously delivered. Rationalisation and decommissioning plans shall remain without prejudice to the need for CNS infrastructure to include back-up systems for contingency situations.

Digitalisation

Furthermore, digitalisation and automation of ATM are essential SESAR priorities and are progressing very fast. Indeed, several elements of the PCP and of the Deployment Programme contribute to digitalisation as Electronic Flight Strips, A-SMGCS routing and planning, Datalink and the Extended Projected Profile down-link.

Having an advanced digital infrastructure will be key to enhancing capacity (both airspace capacity and airport capacity), increasing operational efficiency, reducing costs, delays, reducing fragmentation and enabling new services (e.g. drone-based, mobility, peer-to-peer services etc.).

Flight Object IOP

Flight Object IOP is one of the most promising enabling components allowing operational stakeholders to share detailed flight information and coordination in real time and all stages of the flight. This capability is key for future optimization of European Airspace and Trajectory Based Operations (TBO). This is clearly illustrated in the Airspace Architecture Study published by SJU.

Flight Object IOP has been undergoing through validation in S2020 and an intermediate successful validation of the En-Route to En-Route ATC operations took place in 2019. Work is ongoing in SESAR to update the EUROCAE's ED-133 Flight Object interoperability specification, which will be the basis for its implementation.

Cybersecurity

[2] Digitalisation: the way in which many domains of ATM are restructured around digital communication and media infrastructures enabling, improving and/or transforming business operations and/or business functions and/or business models/processes and/or activities, by leveraging digital technologies and a broader use and context of digitized data.

Essential for digitalisation and automation is cybersecurity, which has become necessary for innovative technologies and digital systems as well as for legacy systems so as to ensure and protect safety and security in ATM.

Security, in particular cybersecurity needs to be addressed for each and every part of the ATM system of systems as well as globally so as to ensure service continuity and resilience. This obviously includes securing data exchanges within the context of SWIM but is not limited to this new paradigm for information exchange.

A fully integrated approach taking into account the digitalisation and cybersecurity, should be established and maintained for all the lifecycle phases of the ATM infrastructure. This includes the deployment of new technologies, digital systems and the rationalisation processes, within and outside the Common Projects.

2. SDP Key Deployment Activities

2.1 Data Link Services: Implementation Status and Next Steps

In December 2015, the SESAR Deployment Manager was requested by the European Commission to prepare a "*DLS implementation strategy that will encompass all implementation activities still required to get DLS and then AF6 implemented*". Accordingly, SDM developed and successfully consulted with the stakeholders a "Data Link Services (DLS) - Implementation Strategy towards Initial Trajectory Information Sharing", which has been delivered to EC as an addendum to the Strategic View of the SESAR Deployment Programme 2016 on 28th September 2016.

Consequently, EC requested the SDM to derive from the addendum a "DLS Recovery Plan", with the aim of focusing on the concrete and relevant activities to be undertaken in the ground and airborne domains in order to achieve, in the right sequence, a synchronized DLS deployment in Europe.

Taking into consideration the high-level principles concerning the DLS implementation outlined in the addendum as well as the outcomes of the ELSA study, the plan has been structured in the following paths:

- **Path I – Implementation of the DLS transitional solution**: identifying the deployment activities needed to meet No EU (IR) 310/2015 and ELSA's recommendations, focusing in particular on the envisaged transitional solutions (Model B or Model C with Multi-frequency for the ground segment; and "best in class" avionics for the airborne segment);
- **Path II – Preparatory activities towards the target solution**: identifying the steps towards the target solution (Model D), through the implementation of ELSA's.

On 18th October 2016, the EC also mandated the SESAR Deployment Manager to act as Data Link Services (DLS) Implementation Project Manager. The mandate was intended to recover from the fragmented and unsynchronized deployment of DLS in Europe, building on SDM technical expertise and its position as coordinator of the SESAR Deployment Framework Partnership.

Covering its role of coordinator, SDM designed a dedicated DLS cluster for the 2016 CEF Transport Calls, including implementation projects directly contributing to the two paths identified within the DLS Recovery Plan, and in particular:

i. Specific IPs, dedicated to the implementation of the DLS transitional solution for both ground[3] and airborne[4] domains;
ii. A multi-stakeholder IP[5] aiming at supporting SDM in the definition of preparatory activities towards the target solution.

Regarding Path I - ground domain, a coordinated implementation of the DLS transitional solutions in Europe, according to the IR (EU) No 310/2015, has been achieved also thanks to the multi-stakeholder project 2016_161_AF6 "DLS Implementation Project - Path 1 Ground stakeholders", participated by 14 ANSPs and 2 Communication Service Providers[6], concluded in February 2018.

Moreover, from a specific monitoring exercise performed by the SDM, it results that although some Member States implemented DLS in compliance with IR (EU) No 310/2015 February deadline, many of them demonstrated clear plans into implementing DLS. For what concerns the Path I - airborne domain, 7 projects presented within the 2016 and 2017 CEF Transport Calls, aiming at upgrading the avionics to the "best in class" performance, are proceeding on track.

Regarding Path II, preparatory activities towards the implementation of the target solution have been undertaken by the SDM, supported by the implementation project 2016_159_AF6 "DLS Implementation

[3] 2016_161_AF6_GND – "DLS Implementation Project - Path 1 "Ground" stakeholders (GND)"
[4] 2016_165_AF6 – "Lufthansa Group & Air France Group Datalink upgrade to "best in class" avionics"; 2016_061_AF6 - "Deployment of ATN B1 capability within TAP Group"; 2016_125_AF6 - "Airbus A310 ATN VDL2 Compliance"; 2016_126_AF6 – "FALCON 900 compliance with Air Ground ATN VDL2 Data Link"; 2016_164_AF6 - "RYR Upgrade to ATN B1 to best in class"
[5] 2016_159_AF6 – "DLS Implementation Project - Path 2"
[6] Austrocontrol, Croatia Control, DFS, DSNA, EANS, ENAIRE, ENAV, HCAA, Hungaro Control, LFV, LGS, MATS, NAV Portugal, Oro Navigacija, PANSA, SITA INC BV Netherlands

Project - Path 2", participated by 20 ANSPs, 2 Communication Service Providers, European Satellite Services Provider (ESSP) and 3 Airspace Users[7].

Specifically, within Path II framework, the first step towards the target solution concerning in the definition of Service Areas (as the geographical and operational association of homogeneous regions in areas capable of optimizing both their VDL2 RF network deployment and their ground-ground network activity) has been completed. Starting from the Service Areas definition, preliminary technical considerations have been performed, leading to the definition of two architecture proposals, although a set of technical open points have been identified and needed to be further investigated. The main results of these two activities have been outlined in a specific document "Report on Service Areas and DLS Overall Architecture" submitted to EC on the September 29th, 2017.

At the same time, a preliminary analysis of the economic aspects for the definition of the target solution has been performed and is expected to be further refined taking into account detailed data stemming from the resolution of the above-mentioned points and the consequently a more complete picture of the overall technical architecture.

Furthermore, the definition of the future steps and activities, to be put in place to ensure the transition from the models deployed at Country/Region level towards the target solution throughout Europe, is still in progress considering the results achieved so far, and completion date is expected by 2020.

Moreover, the activities related to the definition of a European Common DLS Governance, in terms of roles, responsibilities and processes are under the direct responsibility of Path II Project stakeholders and the completion date is expected by 2020.

Considering the mentioned technical and non-technical open points, identified during the Path II project execution, the SDM has promoted the submission of a dedicated project aimed at solving them, enabling a complete definition of the overall technical architecture. In response, stakeholders have submitted the implementation project 2017_089_AF6 "IP1 - DLS European Target Solution assessment" which addresses these open points. This project, consisting of 21 partners including ANSPs, CSPs and industry and funded under the 2017 CEF Transport Call, will provide the answers to the remaining open points that, at the end, will allow stakeholders to evaluate the efforts and benefits associated with the proposed architecture proposals.

Moreover, a VDL Mode 2 Capacity and Performance Analysis is being performed by the University of Salzburg for SDM to support, through the provision of detailed performance data, the resolution of the above-mentioned open points and assessing the lifespan and performance of VDL Mode 2 taking into account the requirements for handling ATN B2 data services, as mandated by PCP.

At the same time, regarding the airborne domain, according to the regulatory framework the upgrade of "best in class" avionics is proceeding under the coordination of the SDM.

Finally, it is worth mentioning that the adoption of complementary technologies (ground and/or space based) covers a crucial role for DLS future. For this reason, the SDM is strongly committed in their evaluation and consideration, as outlined in the DLS Recovery Plan in order to ensure the mid to long term availability of future DL systems, also ensuring a smooth transition among Data Link systems based on multiple technologies. The VDL2 Capacity and Performance analysis results will be used to consolidate the activities needed to deploy complementary technologies.

Furthermore, the results of the VDL Mode 2 Capacity and Performance Analysis study will be used to define a timely deployment of complementary technologies, in order to ensure the required availability and reliability of current and future DL services. In this context, significant progress has been observed in the field of satellite communication, which represents a solid option as complementary technology, both in terms of performance and fast operational availability. Indeed, at least one solution whose development and validation has been supported by the European Space Agency has recently moved from R & D to its

[7] ANS Finland, Arinc, Austrocontrol, BULATSA, Croatia Control, DCAC, Deutsche Lufthansa, DFS, DSNA, EANS, ENAIRE, ENAV, ESSP, Eurocontrol, Hungaro Control, LFV, LGS, LPS SR, MATS, NATS, NAV Portugal, Oro Navigacija, PANSA, Ryanair, SITA INC BV Netherlands, TAP Portugal.

pre-operational phase, with in flight demonstration by a set of major European Airlines being underway and ongoing implementation of a credible road map towards certification and first service delivery in 2021.

2.2 SWIM Governance Action Plan implementation

Since the publication of the Deployment Programme 2016, the execution of the SDM SWIM Governance Action Plan detailed in DP 2016 started. Phase 1, a set of 4 targeted actions by a group of stakeholders supported by SDM, has been completed, while Phase 2, the execution of the SWIM Governance Deployment Implementation Project, is on-going.

2.2.1 Action Plan

Background

The SDM SWIM Action Plan is built on 2 Phases on the basis of the following assumptions:

1. The readiness of a subgroup of stakeholders to undertake, under the coordination of SDM, preparatory activities for the SWIM Governance Deployment Implementation Project if a minimum financial support could have been provided – (Phase 1);

2. The submission of a new Implementation Project for the deployment of SWIM Governance in response to the 2016 CEF Transport Calls by a wide group of stakeholders and the start of the execution of the project following the INEA awarding decision expected for early summer 2017 – (Phase 2).

Both the assumptions were fulfilled and the work for the implementation of the SDM SWIM Action Plan started in due time. During the preparation of the SWIM Governance Deployment Implementation Project (IP) for the 2016 CEF Transport Calls, the involved stakeholders stressed the very close relationship between Phase 1 and Phase 2, with some of the tasks in Phase 1 being continued as tasks in Phase 2.

Consequently, few changes to the tasks content and planning were agreed with SDM.

2.2.2 Deploy SWIM Governance (2016 CEF Transport Calls IP)

As foreseen by the Action Plan, an enlarged group of 22 stakeholders (12 ANSP, Network Manager, airlines, 3 airports, 1 military stakeholder and EUMETNET) submitted a new IP proposal on SWIM Governance Deployment in response to the 2016 CEF Transport Calls and was granted full co-funding support following the publication of the Call Awarding results by INEA.

The IP started on February 7th, 2017, continuing the Phase 1 tasks of the action plan. The official kick-off meeting took place on March 10th, 2017. The end of the project is scheduled for December 2019.

The project scope encompasses all Phase 2 tasks according to the SDM SWIM Governance Deployment Action Plan. It also adds some tasks foreseen for Phase 1, which have been included into the project based on its earlier start. Namely these are:

- Develop SWIM Compliance Guidance Material;
- Monitor and coordinate common components deployment projects.

In close coordination with SDM, two relevant activities were added to the projects scope:

- Common security requirements;
- International coordination.

Common security requirements aim at kick-starting the implementation of Family 5.1.4 of the Deployment Programme, which is also a common SWIM component. In the description of Family 5.1.4 it is stated that: "*It is recommended that stakeholders launch a common Implementing Project, in coordination with the SWIM Governance, dealing with the topics of security and cyber security of SWIM*". In principle, a similar setup of the project and a similar group of stakeholders as for the SWIM Governance Deployment IP is foreseen.

As stakeholders had clearly indicated that no project would be presented in 2016 CEF Transport Calls, SDM proposed that a first step should be taken by the SWIM Governance Deployment project due to the overlap in topics as well as in participants.

Meanwhile a group of stakeholders has proposed a common Implementing Project in 2017 CEF Transport Calls aiming to implement a common PKI infrastructure and the according governance arrangements. The project shall execute in close cooperation with the SWIM Governance Deployment project.

PKI is a cryptographic technique that enables entities/partners to securely communicate on an insecure public network, as it is defined for SWIM Yellow Profile. PKI makes it possible to verify the identity of an entity/partner via digital signatures, thereby providing the trust between the interfacing partners that is needed in a safety and business critical environment. PKI is a well-known technique, which has proven to be very efficient within other business domains.

The need to deal with international coordination was identified during the cooperation activity with FAA, in which SWIM Governance is one focus area. Hence the results of the SWIM Governance Deployment project are considered to be an input to international coordination and standardization activities, for example in ICAO.

It is important to note that this task comprises the preparation of material for coordination activities, not the participation in any meeting or group itself.

SDM continues its commitment in coordinating the deployment of SWIM Governance by supporting the project execution, e.g. by offering its stakeholder consultation platform for consulting the SWIM Governance deliverables with a wide audience of ATM stakeholders.

Since its start the IP has made substantial progress. The task T02 refining and setting up the SWIM Governance was the first priority of the project and concluded the first iteration of its work. The focus lay on defining the Terms of Reference for the Governance bodies as well as the essential policies guiding the SWIM Governance execution.

The first set of deliverables of this task was delivered mid-2018:

- **SWIM Governance Structure** document, which defines the setup of the SWIM Governance, the tasks of the bodies as well as the Terms of Reference of these bodies.
- The **SWIM Service Provisioning Policy,** which contains detailed statements on the compliance assessment of services and the service registration applicable to service providers. These statements specify what is expected from service providers with regard to the provision of SWIM Services.

These documents form the basis for the initial operation of the SWIM Governance, which started mid-2018. This is the first time that European SWIM deployment and operation is accompanied by a governance controlling its evolution.

In parallel there is ongoing work on the legal setup of SWIM Governance that will be relevant after the end of the project and on security requirements that shall serve as input to the above-mentioned IP on Common PKI and cybersecurity.

2.3 Cybersecurity

This section is an early guidance for ATM investors, who are the final responsible for addressing cybersecurity aspects while deploying the technological elements included within the SESAR Deployment Programme. As stated in section 1, cybersecurity needs to be addressed for each and every part and all stages from R&D to deployment and operations of the ATM systems as well as globally so as to ensure service continuity and resilience.

The objective is to:

- Clarify the relevance of cyber security in the context of SESAR;
- Illustrate potential adverse outcomes if cyber security is not addressed adequately by all stakeholders;
- Support stakeholders in providing useful reference and guidance material.

The European Commission, EASA, the SESAR Joint Undertaking and other EU Organizations and Bodies are still working to setup a comprehensive framework to secure operations and minimise the risk of cyber-attacks, therefore this section should not be understood as the final picture and will be updated in future releases of the Planning View.

2.3.1 Cybersecurity in the Aviation environment

Transportation and in particular Aviation have been identified in the EU Directive on Security of Network and Information Systems (NIS Directive 2016/1148) due to their importance for society. Aviation represents an attractive target for a wide range of attackers.

Legacy ATM systems are usually highly customised systems using heterogeneous and often proprietary point to point communication methods. Modern and future ATM systems design, on the contrary, rely on enhanced interconnectivity and will increasingly make use of Commercial Off The Shelf (COTS) components. Due to their open architecture and wide availability they support the reduction of costs for stakeholders. The vast distribution of COTS components as well as the usage of open standards introduce increased cyber security risks to aviation systems. It is therefore paramount to identify these risks, assess their possible impacts and mitigate them with appropriate measures. SESAR Deployment Manager (SDM) believes that all SESAR Deployment Programme (SDP) Families can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate measures to mitigate them.

The fact that aviation systems are not immune to cyber threads is recognised by ESCP (European Strategic Coordination Platform) and has led to the following Vision, Direction and Objectives, that may serve as a guidance for implementation projects (EASA Strategy Paper is expected to be released mid 2019):

Vision: This Strategy envisages a future aviation system characterised by two main improvements:

The future aviation system is:

- a trustworthy and dependable environment, so that aviation stakeholders will be able to rely on services and information provided by others for the accomplishment of their operational objectives;
- a system-of-systems capable to adapt and therefore, to withstand new threats without significant disruptions, developed through a systemic approach to cybersecurity in aviation of current and legacy systems.

Direction: To achieve the desired improvements, aviation stakeholders agree that the common effort shall focus in two directions.

As a guiding policy, the collective effort is focused on:

- Making Aviation an evolutionary cyber-resilient system, which, under attack, can maintain its functionalities.
- Making Aviation self-strengthening by adopting a "built-in security" approach, which consider, since systems' conception, security objectives that need to be achieved along with traditional operational and safety objectives.

Objectives:

Objective	*By ensuring that*
Improve cyber resilience	• Operations continuity assurance is enforced with distributed protection along functional chains; • Operational Systems can fail gracefully by ensuring continuity of essential services; • Operational Systems adopt multi-layered protection measures that hinder the progress of an attack; • Aviation stakeholders understand the trans-organisational nature of the Aviation system and make use of connections to collaborate;

Objective	By ensuring that
Self-strengthening aviation system by implementing a built-in security approach	• Systems design practices are in place to avoid unintended use of functions exposed to users; • Systems design practices are in place to assess the risks of loss of security attributes and to implement protection measures, including adaptive solutions; • Assurance and scrutiny processes allow for the security effectiveness of systems during the whole lifecycle. • The level of protection against external causes is assessed on event basis and, if necessary, restored.

2.3.2 Threats and consequences

Physical assets range from HVAC (Heating, Ventilation & Air Conditioning) system to controller working position and aircraft, virtual assets range from airline customer database to airspace modelling data. For virtual assets, the data may be stolen, destroyed or tampered with hence becoming unreliable. Be it physical or virtual, the consequences of a cyber-attack may lead to:

- significant and widespread loss of reputation across the industry
- damage to assets
- unavailability of services
- delay and traffic disruptions
- profit loss
- safety breach
- accidents
- etc.

There is also the virtual – physical dimension, also known as the cyber – physical dimension, where changes in virtual assets through cyberspace have an immediate effect on physical outcomes. This includes for example SCADA systems (Supervisory Control And Data Acquisition) which monitor and control operations at an airport or remote facilities (e.g. a radar station).

2.3.3 Available Regulation and guidance material

In order to minimise disruption of operations, resilience has always been essential to the performance of the air transport system. Resilience at the elementary system level is a first step but resilience at business level also needs to be ensured, holistic business continuity plans should therefore be elaborated by operational stakeholders.

Investments in cyber security have become necessary to ensure safe and timely operations. In regard to existing resource constraints and economic pressure, we must however be proportionate and ensure we are following a responsible, documented and risk-based approach. All stakeholders should anticipate that their NSA will require them to provide evidence on security risk assessment.

Notwithstanding what NSA's may request from their operational stakeholders, here is a list of regulations, standards and guidance documents which are sometimes targeting a specific audience but may inspire good practises across the whole community.

For States and "operators of essential services"

- The Network and Information Security (NIS) Directive (2016/1148) requests Member States to identify "operator of essential services" by 9 November 2018 and lists for air transport the following organisations: air carriers, airport managing bodies and traffic management control operators. The NIS directive also requests the States to ensure that "operators of essential services" take:
    1. "*Appropriate and proportionate technical and organisational measures to manage the risks posed to the security of network and information systems which they use in their operations. Having regard to the state of the art, those measures shall ensure a level of security of network and information systems appropriate to the risk posed*".
    2. "*Appropriate measures to prevent and minimise the impact of incidents affecting the security of the network and information systems used for the provision of such essential services, with a view to ensuring the continuity of those services*".

For ANSPs and NM:

- Commission Implementing Regulation 2017/373 of 1 March 2017 laying down common requirements for providers of air traffic management/air navigation services and other air traffic management network functions and their oversight, in its requirement "ATM/ANS.OR.D.010 Security Management" states that:
  - (a) *Air navigation services and air traffic flow management providers and the Network Manager shall, as an integral part of their management system as required in point ATM/ANS.OR.B.005, establish a security management system* […]
  - (d) *Air navigation services and air traffic flow management providers and the Network Manager shall take the necessary measures to protect their systems, constituents in use and data and prevent compromising the network against information and cyber security threats which may have an unlawful interference with the provision of their service.*

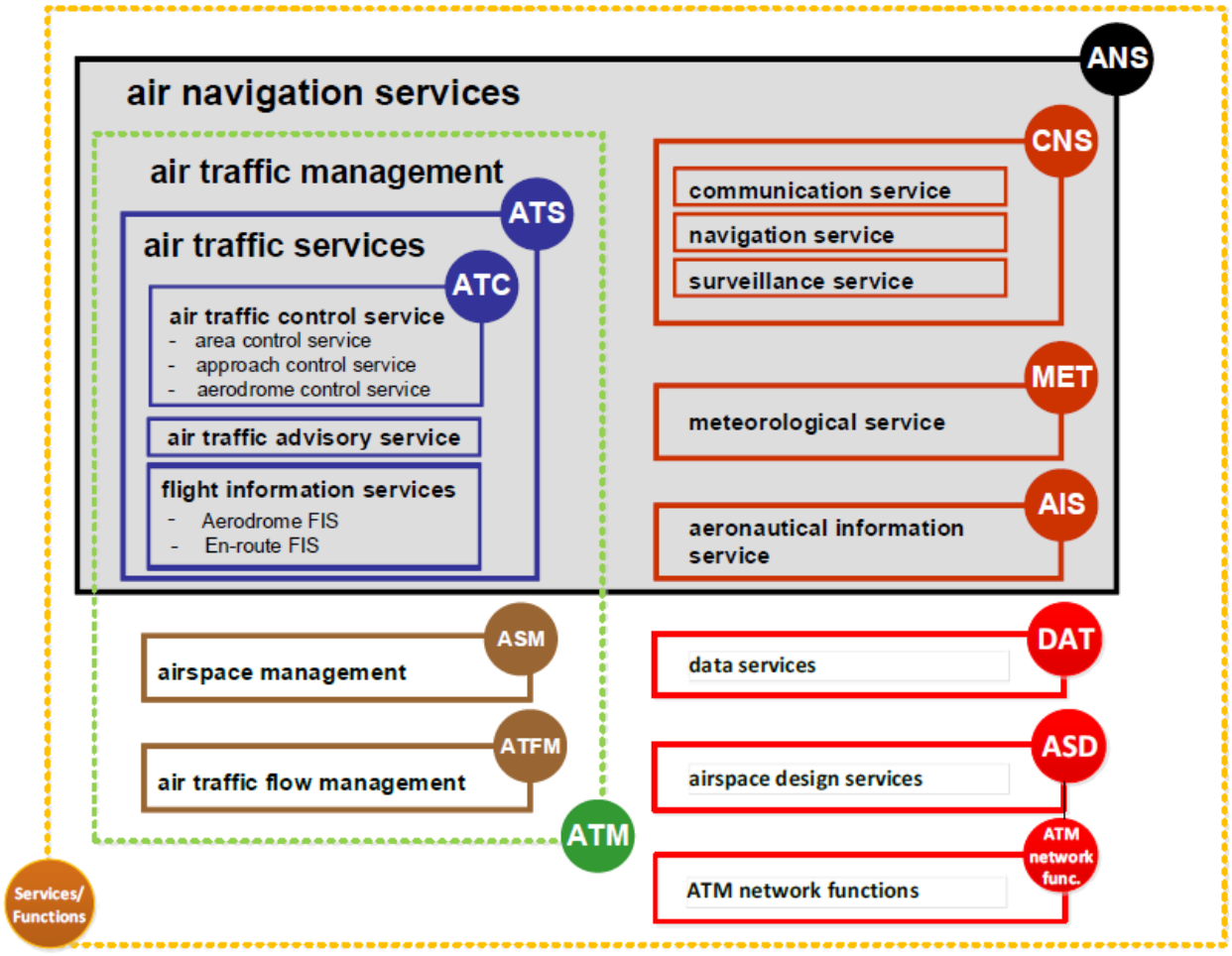


Figure 2 - The scope of the services as specified in Annex Vb to Reg. (EC) No 216/2008 and, additionally, the other ATM network functions (Source: Easy Access Rules for ATM-ANS (Reg. (EU) 2017/373))

- ED 205 Process standard for Air Traffic Management/Air Navigation Services (ATM/ANS) ground system security aspects for certification/declaration
- CANSO Cyber Security and Risk Assessment Guide

For all stakeholders:

- General Data Protection Regulation (GDPR) (Regulation (EU) 2016/679) on the protection of natural persons with regard to the processing of personal data and on the free movement of such data
- Regulation 2019/2019/881 on ENISA (the European Union Agency for Cybersecurity) and on information and communications technology cybersecurity certification
- ITU X.1205 "Overview of Cybersecurity"
- CEN EN 16495 "Information security for organisations supporting civil aviation" builds on the structure of the ISO/IEC 27000 family - Information security management systems

- ISO 27000 family of standards are focused on information security matters:
  - ISO 27001 - Information technology — Security techniques — Information security management systems — Requirements
  - ISO 27002 - Information technology — Security techniques — Code of practice for information security management
  - ISO 27003 - Information Technology — Security techniques — Information security management system implementation guidance
  - ISO 27004 - Information technology — Security techniques — Information security management — Measurement
  - ISO 27005 - Information technology — Security techniques — Information security risk management
  - ISO 27006 - Information technology — Security techniques — Requirements for bodies providing audit and certification of information security management systems
- NIST Cybersecurity Framework

Furthermore, here below some recommendations:

1. **Ensure Competency**: ensure that you have a Chief Information Security Officer (CISO) who is competent for the task and who has the backing of his high-level management.
2. **Maintain a Cyber Risk Assessment**: Investments have to be proportionate to the threat. In order to do this, risk assessments need to be performed. It is important that any cyber risk assessment is updated at least every 6 months. Favour low cost, simple and repeatable risk assessment techniques, know your key assets and get independent experts to validate them;
3. **Control your Supply Chain**: Once you introduce defences identified in a risk assessment, suppliers can still undermine your cyber security. Ensure they follow a documented cyber security policy by enforcing appropriate contractual agreements;
4. **Exercise Cyber Resilience**: nobody can guarantee that they are totally secure against all cyber threats. Cyber risk assessments help identify potential attack scenarios. These scenarios can be used to exercise your ability to recover from a potential incident;
5. **Act now.**

2.4 Global Interoperability

The analysis of the necessary harmonisation of the main technological developments and evolution, as well as the necessary synchronisation needs, is at the cornerstone of the SDM effort to contribute to global interoperability. Special reference is given to the risk of lack of global interoperability, which has been representing a key concern for airspace users in the SDM stakeholder consultation process since 2015.

The United States FAA's NextGen and European Union's SESAR project are the two largest ATM modernisation programs currently under way. The cooperation between US FAA and EU SJU and SDM is instrumental to achieve global interoperability of ATM systems and to support harmonisation of standards, technologies and procedures on deployment matters. The SDM has committed to work on a complete life cycle view (definition, development, deployment) of both NextGen and SESAR, confirming the importance of promoting SESAR as one project. With respect to cooperation with the FAA and global harmonisation the SDM works therefore closely with the SJU, ensuring a single SESAR view to the international stakeholders' community.

Framework and guidance from Policy Level

The international activities of SDM take place under the oversight of the policy level led by the European Commission.

Regarding European cooperation with FAA, the European Union and the United States of America have concluded and signed in December 2017 an amended MoC on "Air traffic management modernization, civil aviation research and development and global interoperability". This amended MoC is encompassing a dedicated appendix on deployment, complementing the appendices on R&D and performance measurement.

The MoC has the purpose to establish cooperation between the two air traffic modernization activities, taking into account the interests of the civil and military stakeholders.

SDM and SJU are working closely together to ensure that SESAR is addressed as a single project, covering the full life cycle view. SESAR and FAA/NextGen are committed to achieve utmost synergies between the different phases of the life cycle of the ATM modernization programs. An analysis on risks, opportunities and issues with respect to global interoperability and harmonization is developed under the scope of the MoC, including respective mitigation measures as part of the MoC management process. The global view, in particular with respect to ICAO activities will be addressed as well to reduce the risk of lack of global interoperability for the operational users of the ATM systems.

State of Harmonisation between SESAR and NextGen

In December 2016, a second edition of the State of Harmonisation Document on the state of US/EU Air traffic modernisation and its programs SESAR and NextGen has been published simultaneously by SJU/SDM and FAA[8], a third edition is provided in fall 2018 in the timely context of the ICAO Air Navigation Conference. The purpose of this regular publication is to provide a high-level summary of the current state of progress towards achieving the necessary level of harmonisation and global interoperability between NextGen and SESAR. More broadly, the publication reflects the current and planned collaboration efforts by the United States and the European Union to harmonise and secure the modernisation of air traffic management bilateral as well as globally in support of the ICAO Global Air Navigation Plan (GANP) and its Aviation System Block Upgrade (ASBU) Programme.

The European deployment stakeholders are continuously invited by SDM to contribute with their views and expectations on all matters related to global interoperability and harmonisation via the SDM Stakeholder Consultation Platform and via the consultation activities of the Cooperative Arrangements on the different key technical issues. The amended MoC is providing the right framework to further exploit the SDM-FAA cooperation, in particular with respect to the implementation of DataComm, SWIM, PBN and AMAN.

Both NextGen and SESAR recognise the need to integrate the air and ground parts of their respective ATM systems by addressing efficiency needs of flight trajectories planning and execution and the seamless and timely sharing of accurate information. The US–EU harmonisation work aims to ensure that modernisation and advances in aviation and in the air navigation systems worldwide can be made in a way that supports a high-performing aviation system over time and global cooperation leading to seamless operations and safe and efficient practices for the airspace users and the travelling public.

Impact in the SESAR Deployment Programme and ICAO work

As outlined above, it is foreseen to regularly incorporate outcomes from the SDM-FAA cooperation work into the functional views of the SESAR Deployment Programme in order to complement it with a wider global perspective. The stakeholders of the SDM will be regularly informed on the progress of work and regularly requested for further input, to prioritise the activities of the deployment cooperation between SDM and FAA. The SDM will make use of the consultation processes in context of regular updates of the SDM Deployment Programme (DP), the SDM stakeholder consultation platform (SCP) communication mechanisms and of the mechanisms of the cooperative arrangements (CAs) according to Regulation (EU) no. 409/2013.

With respect to ICAO SARPs and guidance material related to deployment, SDM will work in close cooperation with SJU, feeding and supporting the relevant working groups at European level on deployment matters, under the guidance of EC.

[8] NextGen – SESAR State of Harmonization (Second Edition) – 2016, prepared by the Coordination Committee (CCOM) for the US-EU MoC Annex 1 High-Level Committee

3. Short-term Deployment Approach

In the SESAR Deployment Programme, a deployment approach for each ATM Functionality has been defined. The interdependencies among the families are also identified, providing the different linkages (enhancement or prerequisite) and stressing the need of synchronising certain families.

The deployment approach for each AF and Sub-AF represents the sequencing of the deployment activities (e.g. of specific families) associated to an ATM Functionality and corresponds to the preferred approach to be followed by operational stakeholders impacted by the PCP Regulation and therefore requested to invest in the implementation of new technologies and/or operational improvements.

By construction, the recommended deployment approaches per ATM Functionalities are stable in time and could only be changed at the occasion of an evolution of the Common Project regulations.

In the Planning View, the deployment approach also identifies the short-term elements needed to achieve the overall AFs deployment in accordance to the deadline set by the PCP regulation. Indeed, following this approach, the intention is to propose the required Short-Term Implementation Needs as the basis for the Commission to identify priorities for awarding EU financial incentives.

These short-term elements, identified through the SDP families, may evolve in future editions of the Planning View, as the implementation progresses. This is a living section whose aim is to reflect only the short-term needs.

The short-term deployment approach is supported by three fundamental pillars: technical considerations, status of implementation in Europe, and performance contribution.

The technical aspects rely on the need to deploy a given family in order to successfully achieve the overall AF or Sub-AF from a technology perspective (systems and procedures). This implicitly means that the families identified in the short-term deployment approach are paramount prerequisites to continue and progress with the deployment of the functionality. In some cases, it also happens that the families within an AF are prerequisites for families belonging to a different AF. In these cases, it is key to provide a transversal view by highlighting the interdependencies and identifying which are the prerequisites.

The status of implementation, based on the Monitoring View, gives the actual picture of the current deployment of a given family in the requested places. The PCP Regulation defines the sites that must deploy each ATM Functionality and sub-Functionality. The SESAR Deployment Programme is the tool to achieve the successful deployment on time of all the sub-Functionalities, and therefore it is needed to identify where there are gaps in terms of implementation and also to monitor how the deployment is progressing across Europe. Depending on the implementation gaps identified with the Monitoring View, and also depending on the technical need to deploy a given family described in the SDP, it will be paramount to focus and push for its deployment. This would derive on including those families in the short-term deployment approach.

It is important to note that being part of the short-term deployment approach does not necessarily imply that a family is the most important within the Sub-AF, either from a performance or technical perspective. This means that the family is only considered important for short-term deployment if there is a global lack of implementation. For example, a Family can be currently part of the short-term deployment approach due to the lack of implementation projects but could be removed from the short-term deployment approach in the upcoming edition should implementation have progressed (i.e. implementation projects are in the pipeline). This could also be extended to the inclusion of another Family in the short-term deployment approach in the future, as a continuation of the implementation of the Sub-AF.

Finally, the performance aspects must be taken into account in order to secure the positive CBA of the PCP. Those families that are mostly contributing to the 4 main KPAs require special attention and care from the deployment and monitoring perspective. Including those families with great performance impact will protect the overall realisation of benefits for each sub-Functionality. Therefore, the short-term deployment approach will be complemented with a description of the performance contribution from each AF and Sub-AF, and when possible, these benefits will be monetised extrapolating them until 2030.

It has to be noted that the monetisation of benefits, and the estimation of fuel, CO_2 and delay savings are based on the existing implementing projects (real data) but also on an extrapolation of those other projects still to be implemented in order to achieve the full deployment of each family.

All these three key pillars combined will support the identification of the short-term deployment approach and will allow SDM to focus its efforts on monitoring and supporting the implementation of the identified families by the required operational stakeholders.

How to interpret the short deployment approach diagrams

The deployment approach diagrams are represented following a PERT-like (Program Evaluation and Review Technique) orientation, using nodes and arrows to represent the milestones and activities. However, the short term deployment approach diagrams have some specific characteristics which lead to some differences with the standard PERT diagram representation. The aim of the deployment approach diagrams is to show the interdependencies of the families in a nutshell, and also provide an indicative typical duration to implement each of them, together with orientative intermediate dates. This would help SDM monitoring the PCP progress and identifying potential risks when the implementation is lagging behind the typical duration, allowing an ad-hoc support from SDM to the relevant operational stakeholders.

The families shown here do not represent activities as defined in the PERT or the PDM (Precedence Diagram Method) despite they are depicted with arrows. However, an analogy between activities and families can be done in order to facilitate the visualisation of the interdependencies within each ATM FUnctiontionality and the sequence for its deployment.

Each family has been represented by coloured arrow:

- Green: When it is a facilitating family
- Orange: When it is a complementary family
- Blue: When it is a core family

The families have been represented taking into consideration their interdependencies, meaning that some of the families can be implemented in parallel, whilst others need to be implemented in sequence. Each family (arrow) starts from a bubble or node and ends in another node. The tipycal duration to implement a given family has been displayed (in brakets) together with the title of the family above or under each arrow. The bubbles or nodes represent the milestones, meaning that a given family has been fully implemented. It has to be noted that the facilitating families (green arrows) have not been taken into account when computing the total durations (since they are not mandatory by Regulation and therefore not strictly needed to be deployed). To reflect this in the diagrams, the facilitating families nodes (always depicted in green) include a Not Applicable (N/A) text on the top.

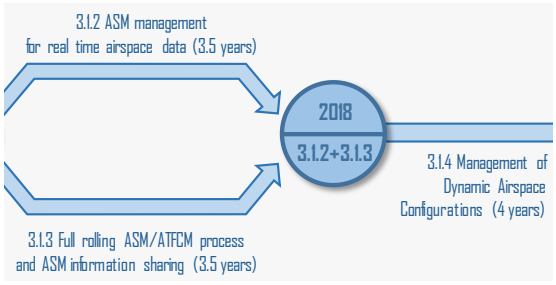


Figure 3 - Example of the sequencing of some Families

In the following example (Figure 3 - Example of the sequencing of some Families) it has been represented that families 3.1.2 and 3.1.3 are enhancing the ASM targeted in Family 3.1.4, and at the same time, 3.1.2 and 3.1.3 can be implemented in parallel. Within the bubbles, two pieces of information are given: the intermediate target date by when the prerequisite Families should be deployed and the reference code of the family/families in the SDP.

The numbers on the top side of the nodes represent the intermediate target date of each family. These dates are derived from the estimated typical duration of the families, which is based on the existing implementing projects and expert judgement when there is not enough actual data. These intermediate target dates are not mandatory by Regulation, but they are useful when assessing the risks to timely implement the ATM Functionalities according to the PCP targed dates.

Figure 4 - Example of a node with an intermediate date and a Family code

In the example shown in Figure 4, the date (2020) on the top of the node means that the family would have to be fully implemented by 2020. This is not a mandatory target date, but an intermediate indication to help SDM and the operational

stakeholders to understand by when (typically), the intermediate families should be deployed in order to achieve the timely implementation of the PCP Functionalities.

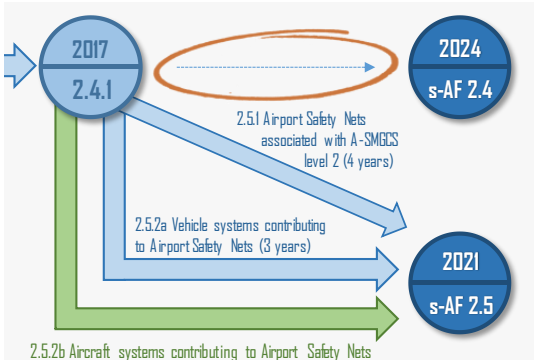


Figure 5 - Dotted line example

Finally, the reference code that appears at the bottom of each node represents the milestone of those families having been fully implemented.

To properly represent the sequence of the families, dotted lines have been used when some families are predecessors or prerequisites of other families or Sub-Functionalities. In the example shown in Figure 5 - Dotted line example, the dotted arrow connecting the two blue nodes means that Family 2.4.1 is a prerequisite to achieve the SubFunctionality 2.4.

AF1 – Extended AMAN and Performance Based Navigation in the High Density TMAs

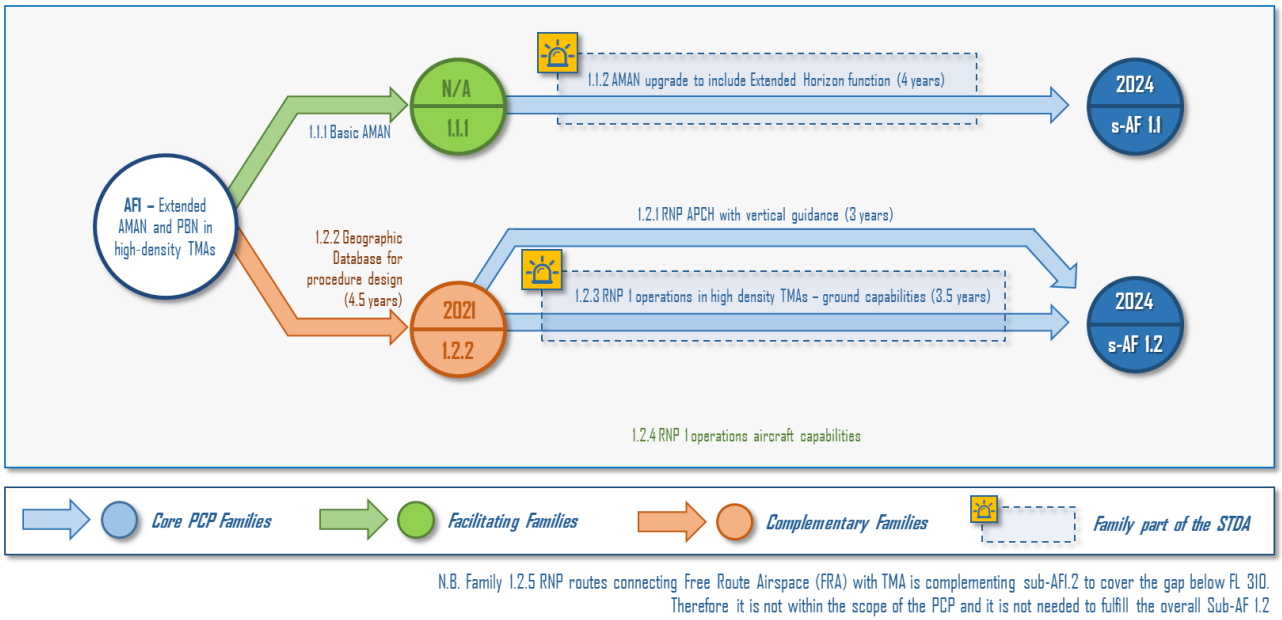


Figure 6 - AF1 Short Term Deployment Approach

AF1 is divided into two Sub-AFs: Extended AMAN and PBN in high density TMAs.

Sub-AF 1.1 - **Extended AMAN**: the short-term deployment approach shall focus on Family 1.1.2 AMAN upgrade to include Extended Horizon function. This Family is the core of the Sub-AF, and with its implementation, Sub-AF 1.1 of the PCP will be achieved. The required technology has been validated in SESAR and is considered mature for deployment, although additional local validations may be needed in particularly challenging environments where multiple PCP airports are in close proximity affecting each other's arrival planning horizons.

In terms of current status of implementation, whilst Basic AMAN is already available for more than half of PCP Airports (16 of 24) and progressing in the remaining, the deployment of Extended AMAN is ongoing, having reached partial results from the Network Manager and in more than half of 24 applicable airports. Moreover, in 4 airports the deployment is almost completed (for instance, Copenhagen Kastrup, London Heathrow, Frankfurt Airport and Munich Josef Franz Strauss).

The Performance contribution linked to the implementation of Family 1.1.2 is shown in the table below:

Saving in minutes	**ASMA unimpeded**	**7,456,675 min**
	ASMA additional	**357,242 min**
	ATM Airport Delay	**114,298 min**

Fuel and CO_2 savings	Contribution Fuel savings in the airborne en-route phase [0,044 tons/ASMA min]	**343,812 tons**
	Contribution CO_2 savings in the airborne en-route phase [3,149 tons/ton CO_2]	**1,083,009 tons**

Figure 7 - Performance benefits referring to full implementation of Family 1.1.2

The Regulation states that the Extended AMAN must be ready by January 1st, 2024, therefore, by the end of 2019 there will be 4 years left to complete the implementation in the remaining airports. According to the estimated typical duration to implement the Family, in order to achieve the target date, the deployment plans should start by end of 2019 the latest.

Sub-AF 1.2 - **PBN in high density TMAs**: the short-term deployment approach should focus on Family 1.2.3 RNP 1 Operations in high density TMAs (ground capabilities). This Family includes the RNP 1 SIDs and STARs and the potential use of the Radius to Fix (RF) path terminator where benefits are enabled for noise exposure, emissions and/or flight efficiency, which are the core of Sub-AF 1.2 together with the RNP approach procedures (Family 1.2.1). The short-term focus is on Family 1.2.3 because of the importance of implementing RNP1 in in the PCP geographical scope.

Although RNP APCHs procedures are already in operations in 9 airports (all RWYs) and at least one landing runway in 20 of the 24 PCP Airports, the implementation of RNP1 procedures is still in its earliest phase as deployment has been completed only in 1 PCP airport. However, Stakeholders already started the implementation activities in the wide majority of the remaining airports.

The Performance contribution linked to the implementation of Family 1.2.3 is shown in the table below:

Saving in minutes	**ASMA unimpeded**	**15,420,051 min**
	ASMA additional	**2,221,416 min**
Fuel and CO_2 savings	Contribution Fuel savings in the airborne en-route phase [0,044 tons/ASMA min]	**776,225 tons**
	Contribution CO_2 savings in the airborne en-route phase [3,149 tons/ton CO_2]	**2,445,107 tons**

Figure 8 - Performance benefits referring to full implementation of Family 1.2.3

AF2 – Airport Integration and Throughput

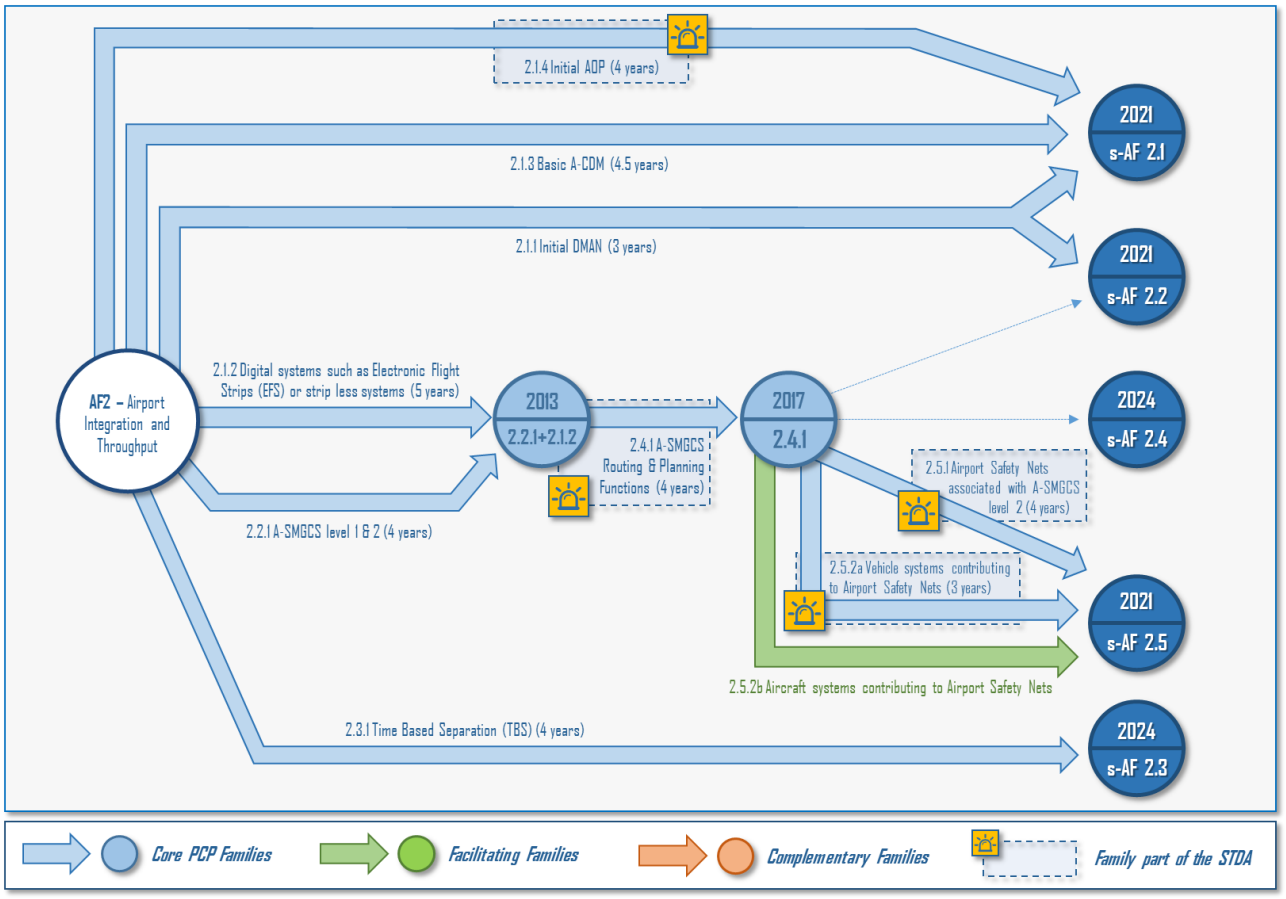


Figure 9 - AF2 Short Term Deployment Approach

AF2 is divided into five Sub-AFs: Departure Management Synchronised with Pre-departure sequencing, Departure Management integrating Surface Management Constraints, Time-Based Separation for Final Approach, Automated Assistance to Controller for Surface Movement Planning and Routing and Airport Safety Nets.

The short-term deployment approach for AF2 should focus on the Families with a target date of 01/01/2021, namely Families 2.1.4, 2.5.1 and 2.5.2. It should also focus on Family 2.4.1 (with target date 01/01/2024) since some of its elements are essential prerequisites for the implementation of Family 2.5.1 and Family 2.5.2.

The highlighted Families could be considered as a first Package on Performance composed of Families 2.1.4 and a second Package on Airport Safety composed of Families, 2.4.1, 2.5.1 and 2.5.2.

The Regulation states that the Airport Safety Nets functionalities must be ready by January 1st, 2021, therefore, by the end of 2019 there will be 1 year left to complete the implementation of Families 2.5.1 and 2.5.2 in the remaining airports. According to the estimated typical duration to implement the related families, the deployment plans for A-SMGCS should have already started and be in progress. In addition, some elements of Family 2.4.1 "A-SMGCS Routing and Planning" Functionalities are essential prerequisites to implement Families 2.5.1 and 2.5.2. Therefore, according to the estimated typical duration to implement the Family 2.4.1, the deployment plans for A-SMGCS should have already started and be in progress. This is the reason why SDM has proposed to the EC to move the FOC of Families 2.5.1 and 2.5.2 to 01/01/2024 in order to align it with the FOC of Family 2.4.1. Otherwise there is a clear risk of a late implementation regarding Families 2.5.1 and 2.5.2.

Time-Based Separation must be ready by January 1st, 2024, therefore, by the end of 2019 there will be 4 years left to complete the implementation in the remaining airports. According to the estimated typical duration to implement the Family, in order to achieve the target date, the deployment plans for Time-

Based Separation should start by end of 2019 the latest. Should Family 5.4.1 (SWIM Met information) not be available, then Family 2.1.4 (iAOP) must be implemented to feed the Meteo information to TBS.

Sub-AF 2.1 – Departure Management Synchronized with Pre-departure sequencing: As described in Family 2.1.4, the Airport Operations Plan (AOP) is the element that reflects the operational status of the Airport and therefore facilitates Demand and Capacity balancing. It is a single, common and collaboratively agreed rolling plan available to all airport stakeholders whose purpose is to provide common situational awareness and to form the basis upon which stakeholder decisions relating to process optimization can be made. The ATM stakeholders' planning processes and working methods are included in the AOP. This means that it is the tool to enable an optimized pre-departure sequencing with information management systems for airspace users and airport.

Initial DMAN and A-CDM are essential prerequisites and essential requirements to the implementation of Initial AOP. They are widely available amongst the PCP airports.

Family 2.1.4 is linked with Family 4.2.4 AOP/NOP information sharing, being the AOP a prerequisite to achieve the full implementation of 4.2.4. Therefore 2.1.4 is paramount to complete Sub-AF 4.2 implementation.

The current implementation of Initial AOP in Europe has achieved the full deployment of the Family only in two Airports, London Heathrow and Zurich Kloten. Activities are marked as on-going for 20 additional Airports, in most cases supported by the submission of multi-stakeholder Implementation Projects presented within the 2017 CEF Call for Proposals, that is contributing to speed up the implementation toward final deadline, currently set for January 2021.

The Performance contribution linked to the implementation of Family 2.1.4 is shown in the table below:

Saving in minutes	**ATC Delay**	**81,686 min**
	ASMA additional	**84,644 min**
	ATFM Airport Delay	**83,911 min**
	Taxi-out additional	**4,467,998 min**
Fuel and CO_2 savings	Contribution Fuel savings in the airborne en-route phase [0,044 tons/ASMA min]	**3,724 tons**
	Contribution Fuel savings on the Taxi-Way [0,010 tons/Taxi min]	**44,680 tons**
	Contribution CO_2 savings in the airborne en-route phase [3,149 tons/ton CO_2]	**152,474 tons**

Figure 10 - Performance benefits referring to full implementation of Family 2.1.4

Sub-AF 2.4 – Automated Assistance to Controller for Surface Movement Planning and Routing: A-SMGCS for Routing and Planning Functions is not yet deployed, as no gaps have been yet closed by the Operational Stakeholders implementing this technological element. Nonetheless, the deployment activities have either just started or are planned in almost all PCP Airports.

Sub-AF 2.5 – Airport Safety Nets: Currently, the status of implementation of Family 2.5.1 and 2.5.2 is still far from its full completion. Only a few airports have declared full implementation of the Airport Safety Nets, while 5 gaps have been closed with regard to Aircraft and Vehicle Systems contributing to Airport Safety Nets. The vast majority of Operational Stakeholders stated that activities are currently on-going, either with or without the support of CEF funding, in 16 cases for Families 2.5.1 and 2.5.2, respectively.

In general, the functional content of safety related projects will not allow to monetize the operational improvements, nevertheless the cost avoidance, meaning the reduction in the number of reports of accidents and severe incidents, knowing that a single report of incidents can represent an effort of several thousands of euros (direct).

At this stage there is an on-going evaluation, how to monitor the positive changes by implementing these respective projects, knowing that by only following the number of reports it may well be that after implementation of more "robust" safety nets at airports, the workload and tasks of e.g. the Runway Safety Teams increases instead of decreasing, due to more precise and refined identification of incidents and accidents.

AF3 – Flexible ASM and Free Route Airspace

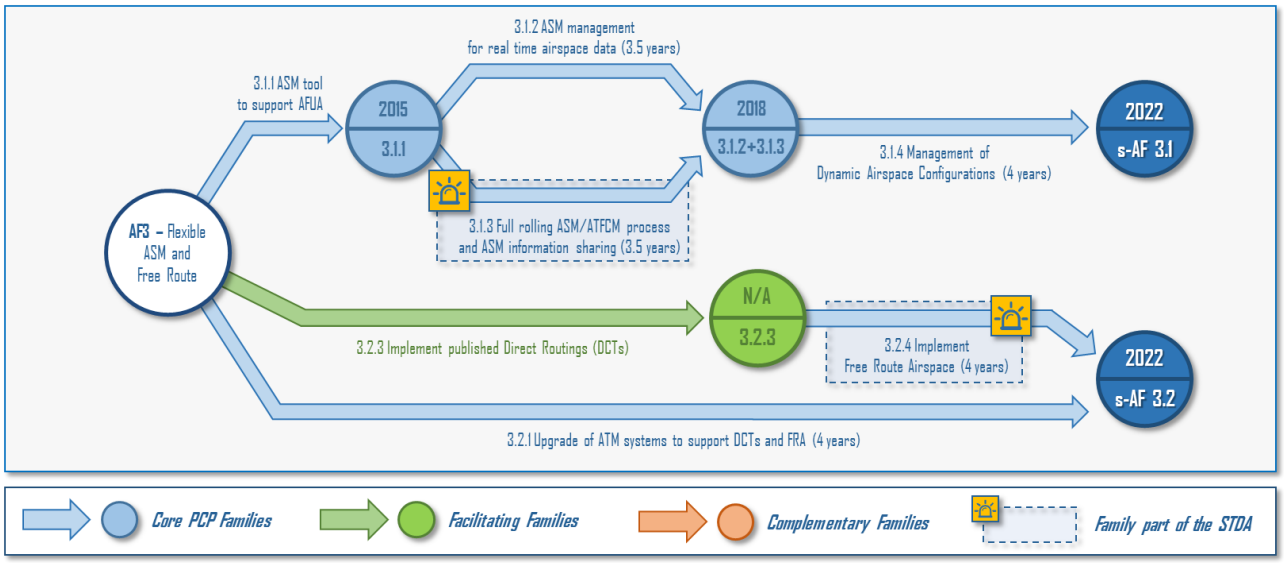


Figure 11 - AF3 Short Term Deployment Approach

AF3 is divided into two Sub-AFs: Flexible Airspace Management and Free Route.

However, benefit expectations for AF3 can only be determined on an overall level due to the high complexity and interdependency between the Sub-Families. It should also be noted that due to the interdependencies benefits can only be achieved on a large scale when the complete AF has been implemented.

The short-term deployment approach for AF 3 should focus on Family 3.1.3 Full Rolling ASM/ATFCM process and ASM information sharing, and Family 3.2.4 Implement Free Route Airspace.

Flexible airspace management and Free Route must be ready by January 1st, 2022, therefore, by the end of 2019 there will be 2 years left to complete the implementation in the mandated geographical scope. According to the estimated typical duration to implement Family 3.1.3, in order to achieve the target date, the deployment of Management Dynamic Airspace Configurations should be already ongoing. Likewise, Family 3.2.4 should be already being implemented by all the States mandated by the Regulation.

Sub-AF 3.1 – Airspace Management and Advanced Flexible Use of Airspace: Full rolling ASM/ATFCM process and ASM information sharing (Family 3.1.3) together with the automated (enabling) ASM tools described in Family 3.1.1, enhances the distribution of information and therefore the management and awareness, on airspace status and availability. It provides support for AFUA and FRA operations and its deployment is practically completed (more than 80% of applicable countries).

The implementation of Family 3.1.3 is currently well-advanced: 22 countries (plus MUAC) have already closed the gap, almost all the others are planning the completion by the foreseen FOC.

In parallel, the implementation of Management of Dynamic Airspace configurations (Family 3.1.4) will determine the completeness of Sub-AF 3.1.

Sub-AF 3.2 - Free Route: Family 3.2.4 Implement Free Route Airspace is the core Family of PCP Sub-AF 3.2. The implementation of FRA requires the availability of certain systems described in Family 3.2.1.

Specific focus should be put on development of suitable procedures, early and comprehensive cooperation between the implementing ANSPs, NM and concerned AU/CFSPs, including testing and validation under consideration of existing ANSPs/NM/CFSPs system capabilities and planned/necessary system upgrades.

E.g.:

- AUs/CFSPs flight plan filing systems to support efficiently the calculation of the most efficient track in FRA and related constraints if present; handling of LAT/LONG.
- ANSPs FDPS and Controller Support tools.
- NM systems adaptations to support growing and extended FRA across Europe.

The current implementation of Free Route registers a positive outlook, due to the majority of gaps already closed (Family 3.2.4) and the already accomplished full deployment of DCTs (Direct Routings). In addition, it is worth noting that all ANSPs declared that implementation activities have either started (7 countries) or are planned (2 countries), however, a final push is needed to fully complete FRA implementation as mandated by the Regulation.

The table below expresses the total expected savings of AF3. A separation on family level is not possible because the interrelations are not clear distinguishable

Saving in minutes	**Through savings in Nautical Miles**	**63,789,041 min**
	Through en-route delay reduction	**292,500,000 min**
Fuel and CO_2 savings	Contribution Fuel savings in the airborne en-route phase [0,060 tons/min]	**3,827,342 tons**
	Contribution CO^2 savings in the airborne en-route phase [3,149 tons CO_2/ tons fuel]	**12,052,301 tons**

Figure 12 - Performance benefits referring to full implementation of AF3

The Regulation states that the FRA must be ready by January 1st, 2022, therefore, by the end of 2019 there will be 2 years left to complete the implementation. According to the estimated typical duration to implement the families, the deployment plans for ASM support enhancements and FRA implementation should have already started and be in progress.

AF4 – Network Collaborative Management

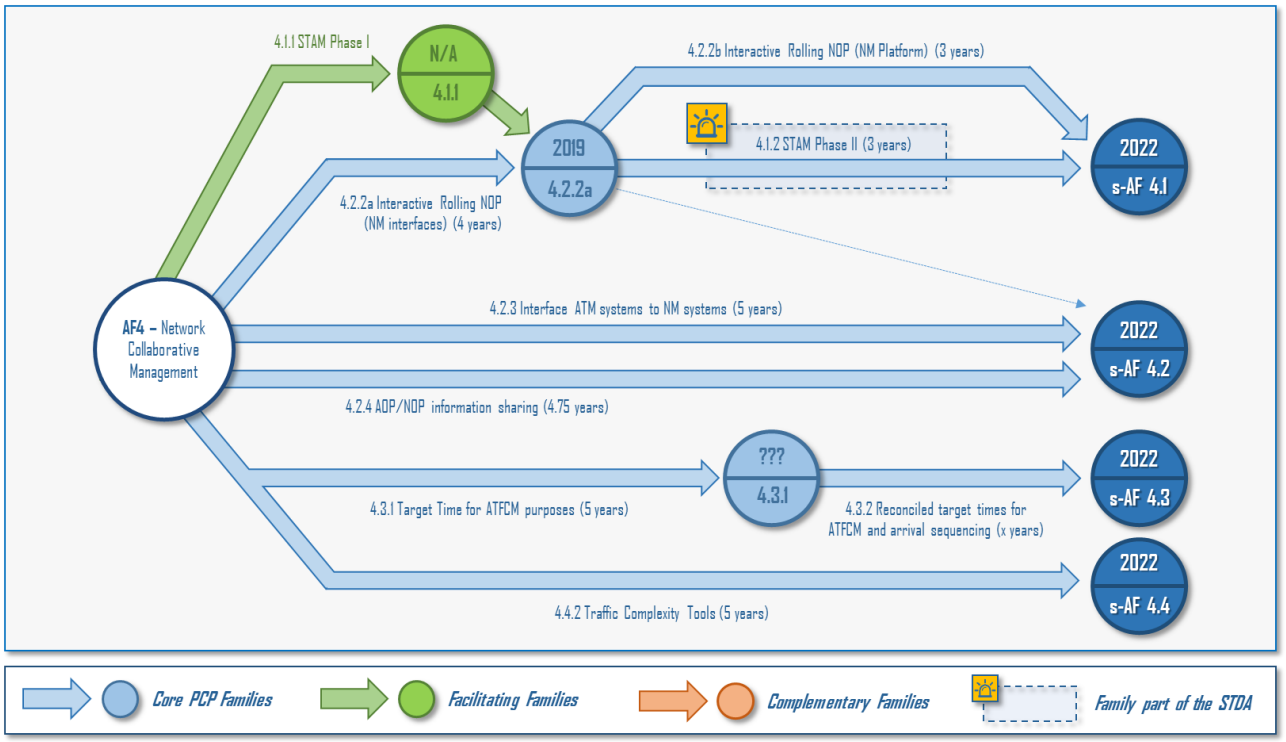


Figure 13 - AF4 Short Term Deployment Approach

AF4 is divided into four sub-AFs: Enhanced Short Term ATFCM Measures, Collaborative NOP, Calculated Take-off Time to Target Times for ATFCM purposes, and Automated Support for Traffic Complexity Assessment.

The short-term deployment approach for AF 4 should focus on Family 4.1.2 STAM Phase II.

Benefit expectations for AF4 can only be determined on an overall level due to the high complexity and interdependency between the Sub-Families. It should also be noted that due to the interdependencies benefits can only be achieved on a large scale when the complete AF has been implemented.

Sub-AF 4.1 – Enhanced Short Term ATFCM Measures: STAM Phase II is considered to be the cornerstone to ensure efficient working relationship between NM, FMP and airspace users.

In terms of current status of implementation, whilst STAM Phase I is available for every applicable country, the deployment of STAM Phase II is still at the planning / early deployment phase.

The Regulation states that STAM Phase II must be ready by January 1st, 2022, therefore, by the end of 2019 there will be 2 years left to complete the implementation. According to the estimated typical duration to implement the Family, in order to achieve the target date, the deployment plans for STAM Phase II should have already started and be in progress.

The table below expresses the total expected savings of AF4. A separation on family level is not possible because the interrelations are not clear distinguishable.

The total expected savings of "En Route ATFM delays" are presenting the value of implementing AF4 projects by showing the avoided delays, which will occur if the technical part of SESAR related functionalities will not be implemented.

Saving in minutes	**Through savings in Nautical Miles**	**17,991,780 min**
	Through en-route delay reduction	**82,500,000 min**
Fuel and CO_2 savings	Contribution Fuel savings in the airborne en-route phase [0,060 tons/min]	**1,079,507 tons**
	Contribution CO^2 savings in the airborne en-route phase [3,149 tons CO_2/ tons fuel]	**3,399,367 tons**

Figure 14 - Performance benefits referring to full implementation of AF4

The Regulation states that Network Collaborative Management must be ready by January 1st, 2022, therefore, by the end of 2019 there will be 2 years left to complete the implementation. According to the estimated typical duration to implement the Family, in order to achieve the target date, the deployment plans for AOP/NOP information sharing should have already started and be in progress.

AF5 – Initial SWIM

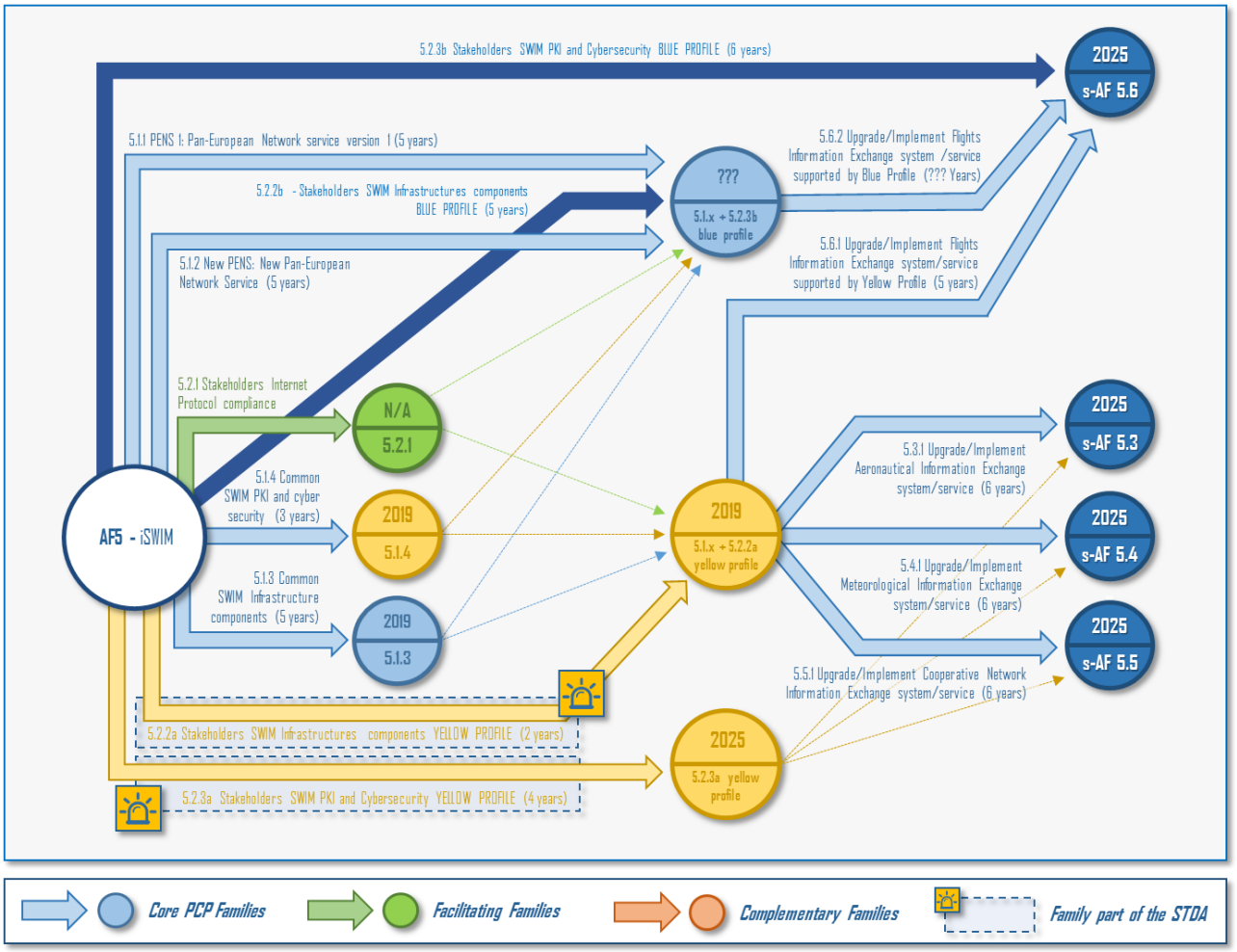


Figure 15 - AF5 Short Term Deployment Approach

AF5 is divided into six Sub-AFs: Common infrastructure components, SWIM Technical Infrastructure and Profiles, Aeronautical information exchange, Meteorological information exchange, Cooperative network information exchange and Flight information exchange.

The short-term deployment approach for AF 5 should focus on Families 5.2.2 Stakeholders SWIM Yellow and Blue Profiles Infrastructures Components and 5.2.3 Stakeholders' SWIM PKI and cyber security. SWIM

Yellow and Blue Profiles are key elements to enable the exchange of Flight Object and future Trajectory Based Operations.

Sub-AF 5.1 – Common Infrastructure Components and 5.2 – SWIM Technical Infrastructure and Profiles: The Stakeholders SWIM Infrastructure components are comprised in Family 5.2.2 and 5.2.3. Together with 5.1.3 and 5.1.4 this enables the Yellow and Blue Profiles, which are the backbone of AF5 and prerequisite for the implementation of the "information" Sub-AFs (the blue bubbles at the end in the illustration above).

It is also essential that the ANSPs requested to deploy Flight Object (Family 5.6.2), implement as soon as possible NewPENS (Family 5.1.2) by joining the first group of ANSPs having initiated NewPENS implementation. As the AF5 supports other AFs, this particular AF should be also considered when implementing the families that are linked. The "information" Sub-AFs shall be deployed in synchronisation with the other AF Families as defined in the interdependencies shown in section 3.2 of the SESAR Deployment Programme.

The deployment of Family 5.1.3 and 5.1.4 is supported by multi-stakeholder Implementation initiatives currently in execution or submitted to INEA in the framework of CEF Call for Proposals. However, additional stakeholders are invited to participate to such initiative, with the aim of contributing to the establishment of the SWIM common components (SWIM Governance and the Public Key Infrastructure) to speed up the implementation of the AF5 toward its final deadline.

The current implementation of Family 5.2.2 and 5.2.3 shows a slight improvement compared to 2018 status. Activities are marked as on-going, either with or without the support of CEF funding, in around half of European countries for Families 5.2.2 and 5.2.3, respectively.

The above-mentioned families and related projects will not generate operational benefits at the first glance. Even more the expectations are based on cost reductions neither on capital expenditures nor on operating cost savings. Both impacts are difficult to define at this early stage, while most of the projects are still in the implementing phase. In accordance to the PCP CBA update, a more detailed questionnaire and closer monitoring of cost avoidance has started to evaluate the possible impacts.

AF6 – Initial Trajectory Information Sharing

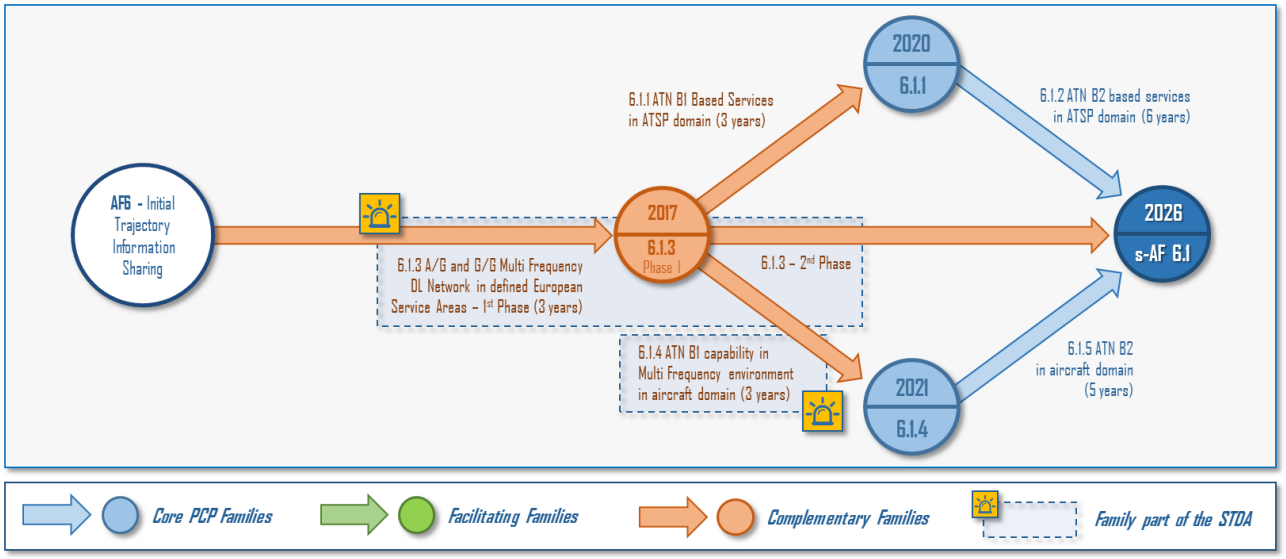


Figure 16 - AF6 Short Term Deployment Approach

AF6 has only one Sub-AF, which is the Initial Trajectory Information Sharing.

The short-term deployment approach for AF 6 focuses on Families 6.1.3 A/G and G/G Multi Frequency DL Network in defined European Service Areas, and 6.1.4 ATN B1 capability in Multi Frequency environment in aircraft domain, which continue to improve the performance of the European VDL Mode 2 network.

Family 6.1.3 provides the communication infrastructure for air/ground data link. The ATN COM domain included in Family 6.1.3 will support both the ATN B1 services required to fulfil the DLS mandate and the trajectory downlinks with EPP (which are part of the ATN B2 services mandated by the PCP).

Deployment of Family 6.1.3 is divided into two phases: Transition from Model A or C to Model B or C with MF in the first phase, and the transition from model B or Model C with MF to Model D in a second phase. The short-term focus is:

- on projects improving the existing VDL Mode 2 network's performance by adding additional channels through the introduction of Multi Frequency, as well as
- on projects preparing the transition to Model D.

In parallel to Families 6.1.1 and 6.1.3, Family 6.1.4 targets the implementation of avionic systems supporting ATN B1 applications.

These three Families are essential prerequisites to move later on to Families 6.1.2 and 6.1.5, which will adapt ground ATM (ANSP/NM) and avionics systems to utilize EPP. In addition, the second phase of Family 6.1.3 will improve the A/G DL network capacity to support the increased data volumes anticipated with the utilization of EPP. This approach will facilitate the objective listed in the PCP Regulation that "*at least 20 % of the aircraft operating within the airspace of European Civil Aviation Conference (ECAC) countries in the ICAO EUR region corresponding to at least 45 % of flights operating in those countries, are equipped with the capability to downlink aircraft trajectory using ADS-C EPP as from 1 January 2026*".

Although Family 6.1.2's readiness for implementation remains at level "low", SDM's focus is to clarify the intended use of the EPP data by ANSP/NM systems to be able to advance the readiness of this Family. The objective is to be able to prioritize the implementation of Family 6.1.2 starting in 2020, so that this Family can be implemented in a timely manner according to the current AF6 implementation target date: The Regulation states that the i4D must be ready by January 1st, 2025, therefore, by the end of 2019 there will be 5 years left to complete the implementation in the ground side.

Regarding the airborne equipage, the SDM is developing a strategy to ensure that at least 20% of the aircraft will be equipped by January 1st, 2026.

Although it is difficult to measure the impact on performance at this stage, an enriched qualitative content of future messages due to better infrastructure (data channels) will allow making even better decisions by all involved stakeholders. The possibility of continuously updating relevant information will reduce decision times and will directly impact i.e. flight times, fuel burn and CO_2 reduction, savings which were already foreseen in PCP too.

Due to the fact that more and faster information to and from the aircraft is available, the corresponding ground systems (E.g. FDP, RDP etc.) can provide better prediction of the available flight profile for Airspace Users. This leads to more efficient aircraft trajectories leading to the above-mentioned savings.

Additionally, where today CPDLC is in operation a significant relief of standard routine voice communication is evident. In fact, CPDLC messaging is much more efficient and less time-consuming: this leads to a capacity increase and safety improvements.

Finally, it is expected that today's capacity constrains could be impacted as well. Beside these quantitative expectations, an impact is expected on safety, because of a much more accurate information sharing via i-4D technologies. These will make possible for the first time to identify movements of aircrafts not only by position and height but by time as well. This information of an additional dimension should have an influence on ATCO productivity, which is difficult to forecast at this stage.

4. Family Descriptions

The SESAR Deployment Programme encompasses the so-called "*Project view*" of the Pilot Common Project, which shall be considered as the core "*operational*" part of the whole document, as it illustrates the 48 Families which regroup the technological and operational elements to be deployed in accordance to Regulation (EU) n. 716/2014. Figure 17 provides the full WBS of all SDP Families, as associated to their respective AF and Sub-AF, also specifying their level of readiness for implementation.

Figure 17 - Overall WBS of the 48 SDP Families

In order to fully complement the information provided within the SESAR Deployment Programme, the following paragraphs provide a detailed and comprehensive description of each of the Programme Families. The main objective is therefore to support Operational Stakeholders in their implementation activities, including the detailed overview of all information required to implement timely the PCP.

To this end, the following tables describe the main features and characteristics of each Family, organized within the following sub-sections:

General Information, providing a snapshot on the Family and illustrating its full technical description, as well as providing some key information to locate it in the framework of the SESAR Deployment Programme:

- Family Number and Title: the colour of the banner indicates the category of the family (blue for "core" PCP families, green for "facilitating" families, light red for "complementary" families[9];
- Main Sub-AF;
- the Readiness for Implementation, which indicates both the readiness for deployment of the Family and the time-wise urgency for the launch of the related implementation initiatives. The Families have been clustered as follows:
    - *High Readiness Families*: these Families are mature for implementation and time wise the most urgent to be deployed in order to continue timely PCP implementation and early benefits delivery;
    - Medium Readiness Families: these Families are ready for implementation, although time wise they are less urgent to be deployed for PCP timely implementation;
    - Low Readiness Families: these Families are not yet ready for implementation but, when developing the future versions of the Programme, will be re-considered as their readiness for implementation is expected to improve in time.
- Initial Operational Capability, to clearly identify the start of the deployment[10];
- Full Operational Capability, to clearly identify the expected end of deployment[11];
- Description and Scope, illustrating the full scope of the technological and operational elements to be deployed to comply with the SESAR Deployment Programme;
- Interdependencies, outlining other Families (or Sub-AFs) whose implementation is strictly connected and related to the Family's deployment;
- Synchronization Needs, highlighting the need for a coordinated deployment and for synchronizing the implementation activities in order to fully achieve the performance benefits; such efforts might involve several stakeholders, combining different stakeholder categories;
- Civil/Military Coordination, focusing on the alignment potentially to be established between civil and military stakeholders involved in the Family's implementation;

[9] According to the SESAR Deployment Programme 2018, in order to better organise the PCP implementation and support stakeholders in the refinement of their investment plans, the 48 families of the Programme have been clustered into three categories:

- *core PCP Families*, regrouping all operational and technological improvements that are explicitly mentioned within the text of Regulation (EU) No 716/2014;
- *facilitating Families*, including implementation activities linked to PCP Sub-AFs, which can facilitate full deployment as an intermediate step to achieving the operational concept. They are not mandatory under the PCP Regulation;
- *complementary Families*, which are linked to the PCP Sub-AFs and are deemed necessary to cover an existing gap not explicitly addressed in the PCP Regulation; they are not mandatory under Reg. (EU) No 716/2014, although they can be mandatory in accordance with other EU Regulations;

[10] Start deployment date for a Family is driven by the start of the first implementation of at least one of the operational improvements/one of the enablers associated with this Family at least in one place with PCP geographical scope. As a consequence, it could happen that a Family has already started to be implemented (Start date = before 2014) whilst not all associated operational improvements/enablers are ready for implementation yet.

[11] End deployment date for a Family occurs when all the operational improvements/enablers associated to this Family have been implemented and put into operational use everywhere within the Pilot Common Project's geographical scope. End deployment date of a Family is expected to occur at the latest by the deadline set by the Regulation (EU) 716/2014 for the associated Sub-AF.

Stakeholders' Categories involved in the Deployment, which outlines the stakeholders impacted by the Pilot Common Project and defines their involvement in the implementation activities:

- Stakeholders considered as gaps, which identifies those stakeholder categories that are requested by the PCP regulatory framework to invest in order to fill in the gaps and therefore are potentially eligible for co-funding under upcoming CEF Transport Calls;
- Other stakeholders involved in the Family deployment, which identifies stakeholder categories which have to be considered as contributors for the full operational deployment of the Family itself, without being necessarily requested by the PCP framework to invest;

References and Guidance Material, which provides the direct reference to the ICAO Global Navigation Plan and to the ATM Master Plan associated to the Family:

- Links to ICAO Global Navigation Plan ASBUs, which outlines the links to Aviation System Block Upgrades (ASBU) included in the latest edition of the Global Air Navigation Plan;
- ATM Master Plan References, which identifies the link to the latest edition of the ATM Master Plan, referring both to Level 2 and to Level 3;
- Cyber security Requirements, which – for relevant Families – reports on the identified requirements to be considered in the deployment of the Family, having specific regard to the potential cyber-threats linked to the increased connectivity associated to the full PCP deployment.

This view is further enhanced and detailed within the dedicated Annex B of the Planning View "Standardization and Regulation Roadmaps", which also includes the following items:

- SESAR Solutions and Very Large-Scale Demonstrations, listing all related operational and technological improvements developed by SESAR members and the associated validation activities, as performed in real operational environments;
- Guidance Material / Specifications / Standards[12];
- Means of Compliance and / or Certifications;
- Regulations;

Recommendations to Stakeholders, which combines targeted recommendations on how to address the Family in the framework of the upcoming CEF Calls with a high-level definition of the key steps that should be followed in the deployment of the required operational and technological elements. The sub-section is therefore composed of:

- Recommendations for IP proposals, which lists the main recommendations to operational stakeholders which aim at launching implementation initiatives linked to the Family;
- Family Deployment Approach, illustrating to potential candidate implementing Partners the suggested approach to be followed in order to deploy the Family. This field will also present and describe the key milestones towards the Family implementation, identifying the activities shall be performed by each of the involved Stakeholder categories. Such milestones are also used during the SDM Monitoring exercise, aiming at identifying the current status of implementation of the PCP throughout Europe.

[12] Guidance material/Specification/Standards can be considered as appropriate and recommended for support to implementation. They can also be referenced in Means of compliance or Regulation. Means of compliance listed in tables are non-binding standards adopted by EASA or ESOs to illustrate means to establish compliance with regulations and implementing rules. However, alternative means for compliance can be applied if accepted by the relevant National Supervisory Authority (NSA). Regulations listed in the tables are binding instruments considered as relevant for the Family implementation.

4.1 AF #1– Extended AMAN and PBN in high density TMA

Family 1.1.1 – Basic AMAN

1.1.1 – Basic AMAN			
Main Sub-AF	S-AF 1.1 Arrival Management Extended to en-route Airspace		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2020
Description and Scope			
Implement Basic AMAN to support traffic synchronization in high density TMAs. Basic AMAN shall: - improve sequencing and metering of arrival aircraft in selected TMAs and airports; - continuously calculate arrival sequences and times for flights, taking into account the locally defined landing rate, the required spacing for flights arriving to the runway and other criteria; - provide automated decision support for sequencing and metering of traffic arriving to an airport; - provide to ATCO as a minimum, simple Time To Lose / Time To Gain - TTL/TTG – information.			
Interdependencies			
Family 1.1.2: Basic AMAN (1.1.1) may serve as an intermediate step towards Extended AMAN (1.1.2). Family 2.1.2: Integration of AMAN information in the Digital systems such as Electronic Flight Strips (EFS) or strip less systems. Family 2.3.1: Integration of Time Based Separation (TBS) with AMAN.			
Synchronization Needs			
Ex-ante synchronization requirements, to be further assessed at the level of Local Implementation Projects. Integration with local ATM systems is necessary to process the flight plan and radar data, which requires defined interfaces to respective ATM system components (FDP, CWP, SDP).			
Civil / Military Coordination			
Coordination with military authorities (AU, ANSP, AD, regulator) as required.			
Stakeholders considered as gaps	ANSPs		
Other stakeholders involved in the Family deployment	Airport Operators		
Links to ICAO GANP ASBUs	B0-RSEQ (Improved Traffic Flow through Sequencing (AMAN/DMAN)		
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	TS-0102 Available	
	ATM Master Plan Level 3 (Edition 2019)	ATC07.1	

Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.
Recommendations for IPs proposal	Where deemed necessary for operational or organizational reasons, Basic AMAN may be implemented as an intermediate step towards Extended AMAN. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.
Family Deployment Approach	The implementation of the Family would require the upgrade of the existing system and/or the installation of an AMAN planning tool supporting applicable sequencing procedures. Such installation would require a final acceptance of the tool and the integration with other existing systems **(MM1 – Installation and Integration)**. The applicable concept of operations shall also be broken down into documented and approved work procedures **(MM2 – Procedures available)**. The elaboration of such operational procedures could also require that the airspace structure and adjacent airports are taken into duly consideration. Before the start of the operational use of the AMAN planning tool, a safety assessment shall be performed successfully **(MM3 – Safety Assessment)** and all operational/technical staff involved shall be duly trained **(MM4 – Training)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.

Family 1.1.2 – AMAN upgrade to include Extended Horizon function

1.1.2 – AMAN Upgrade to include Extended Horizon function			
Main Sub-AF	S-AF 1.1 Arrival Management Extended to en-route Airspace		
Readiness for implementation	High		
Initial Operational Capability	01/01/2015	**Full Operational Capability**	01/01/2024

Description and Scope

Implementation of arrival management extended to en-route airspaces at high density TMAs and its associated adjacent ATSUs.

Arrival Management extended to en-route Airspace extends the AMAN horizon from the 100-120 nautical miles to at least 180 nautical miles from the arrival airport. Traffic sequencing/metering may be conducted in the en-route before top-of-descent, to improve predictability and smooth the flow of traffic.

Extending the AMAN horizon may affect the airspace design, and it is therefore essential that all stakeholders, including military authorities are consulted.

Air Traffic Control (ATC) services in the TMAs implementing AMAN operations shall coordinate with Air Traffic Services (ATS) units responsible for adjacent and up-stream en-route sectors as well as ATS units responsible for inbound traffic originating from airports covered by the Extended AMAN horizon. Input data to Extended AMAN need to be provided by the most accurate trajectory prediction information available (including EFD, CPR, etc.).

- An ATSU operating an Extended AMAN shall be able to send and receive the OLDI AMA message to and from adjacent sectors or to communicate with the relevant sectors - not restricted to adjacent ones - by SWIM services providing advisories to be implemented on aircraft.
- In order to facilitate a timely implementation of the arrival sequence, a sector receiving arrival messages must display arrival management information for the controller.
- ATM systems must be upgraded in order to be able to generate, communicate, receive, acknowledge and display arrival management information (e.g. AMA, B2B).
- Bilateral agreements must be established between involved sectors that could be under the responsibility of different ATC units as well as located in different countries.
- Network Manager may receive the Extended AMAN data, as required, for the overall network impact assessment and relevant network optimisations.
- Arrival sequences handled by Extended AMAN addressing multiple airports needs to be coordinated. Overall network performance must be considered.

The extended AMAN process should include suitable means, systemic, procedural or otherwise, to integrate traffic departing from airports within its extended planning horizon and arriving at the airport/airports served by the AMAN. If Basic AMAN (Family 1.1.1) is already implemented, it might be necessary to upgrade the functionality or consider replacement to meet the requirements and/or to prepare for the automatic coordination with adjacent ACCs as required for AMAN with extended horizon.

Interdependencies

Family 1.1.1: Basic AMAN is a facilitator.

Family 1.2.5: RNP routes connecting Free Route Airspace (FRA) with TMA facilitate stable and efficient sequencing through the whole arrival phase.

Family 2.1.2: Integration of Extended AMAN information in the Digital systems such as Electronic Flight Strips (EFS) or strip less systems to ensure that the arrival sequence is available for controllers as required.

Family 2.3.1: Integration of Time Based Separation (TBS) with Extended AMAN to fine-tune the landing sequence.

Family 3.2.1: Upgrade of ATM systems (NM, ANSPs, AUs) to support Direct Routings (DCTs) and Free Routing Airspace (FRA).

Family 4.3.2: Improved input to Reconciled Target Times for ATFCM and arrival sequencing.

AF 5: Where iSWIM functionality is available, data exchange concerning Extended AMAN shall be implemented using SWIM services.

AF 6: Downlinked trajectory information, where available, shall be used by the Extended AMAN.

Synchronization Needs

When extending the AMAN horizon, synchronization must be made with all affected sectors and Network Manager. Synchronization is also needed to adjust/upgrade the ATM-systems of the adjacent ACC/UACs to process the arrival message provided by Extended AMAN (SW-change, test, integration and implementation).

Family 1.1.2 may be implemented either as a horizon extension of a pre-existing Basic AMAN (1.1.1) or through a fresh implementation from the scratch.

Civil / Military Coordination

Coordination with military authorities (AU, ANSP, AD, regulator) as required.

Stakeholders considered as gaps	ANSPs, Network Manager	
Other stakeholders involved in the Family deployment	Airport Operators, Military Authorities	
Links to ICAO GANP ASBUs	B0-RSEQ Improved Traffic Flow through Sequencing (AMAN/DMAN) B1-RSEQ Improved Airport Operations through Departure, Surface and Arrival Management B1-NOPS Enhanced Flow Performance through Network Operational Planning	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	TS-0305 Available TS-0305-A SESAR Release 4
	ATM Master Plan Level 3 (Edition 2019)	ATC15.1, ATC15.2
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	It is recommended that Extended AMAN is implemented directly, although Basic AMAN can be deployed as an intermediate step. It is also possible to structure the deployment IP so that the horizon is first extended from the Basic AMAN into the en-Route sectors within the same ATSU. The subsequent second stage would then cover the extension to all the other affected en-Route ATSUs upstream. Upstream ATS units are obliged to support the Extended AMAN functionality for the airports within the PCP geographical scope. It is strongly recommended that these upstream ATS units participate in the relevant deployment projects to ensure an effective operation. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	

Family Deployment Approach	The implementation of the Family would require the upgrade of the existing system and/or installation of an Extended AMAN planning tool, supporting applicable sequencing procedures. Such installation would require a final acceptance of the tool and the integration with other existing systems. If applicable, data exchange with the Network Manager is envisaged and local coordination with the Military Authority should be performed, whether necessary **(MM1 – Installation and integration completed including information exchange)**. The applicable concept of operations shall also be broken down into documented and approved work procedures, also considering the proper coordination with Network Manager **(MM2 – Procedures Available)**. The elaboration of such operational procedures could also require that the airspace structure and adjacent airports are taken into duly consideration. Adjacent ATSUs within the Extended horizon shall implement appropriate functionality in their systems to fully support extended arrival management in their sectors **(MM3 – Upstream ATSU Implementation completed)**. Before the start of the operational use of the Extended AMAN planning tool, a safety assessment shall be performed successfully **(MM4 – Safety Assessment)** and all operational/technical staff involved shall be duly trained **(MM5 – Training)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM6 – Implementation completed)**.

Family 1.2.1 – RNP APCH with vertical guidance

1.2.1 – RNP APCH with vertical guidance			
Main Sub-AF	S-AF 1.2 Enhanced Terminal Airspace using RNP-Based Operations		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2021

Description and Scope

Implementation of vertically guided RNP approach procedures (LNAV/VNAV and LPV) in high-density TMAs. RNP APCH utilize the capabilities of the on-board navigation system to provide 3D guidance.

Vertically guided RNP APCH comes in two variations:

- LNAV/VNAV, where vertical guidance is typically provided by the aircraft pressure altimeter. This capability is common in legacy medium and large transport aircraft categories. The procedure features linear lateral guidance to the runway and its vertical component is dependent on local QNH. Limitations of pressure altimetry also result in a minimum temperature limitation below which the approach may not be flown. In the approach chart the minima line is denoted as LNAV/VNAV and is rarely below 350 ft. Note that it is also possible to fly the procedure using SBAS if available from the on-board database.
- LPV, where lateral and vertical guidance is provided by a suitably augmented GNSS sensor feeding the on-board navigation system. EGNOS is the European GNSS augmentation system certified for this purpose. SBAS approach capability is common in Business Aviation and all recent air transport designs. It is also gaining acceptance in the general aviation segment. The procedure features angular guidance to the runway and thus is designed as ILS lookalike in that the sensitivity of the Course Deviation Indicator (CDI) increases the closer to the runway. Depending on the procedure design criteria applied as enabled by available EGNOS Safety of Life (SOL) service parameters, DH can be as low as 250 ft (APV-I) or 200 ft (LPV). The minima line is denoted as LPV in the approach chart.

Points to be noted:

- Airspace users aiming to equip to RNP APCH capability should reference this Family in the proposal.
- State aircraft operation might require alternative means of compliance which are currently under development.
- Mixed mode operation will remain a reality for the foreseeable future; airport operators should exercise due regard for non-equipped traffic.
- RNP APCH was not intended as a replacement of the conventional precision approach, although the LPV-200 variant can be used to substitute a CAT I ILS. All airports in the PCP scope are generally expected or required to remain open in severely adverse weather conditions and thus are dependent on their installed ILS CAT II/III capabilities.

RNP APCH provides superior performance to conventional non-precision instrument approach; airport operators are encouraged to employ RNP APCH as the primary contingency for ILS, withdraw conventional non-precision procedures and decommission the related nav-aid infrastructure, subject to local traffic equipage rates and capability.

Interdependencies

Family 1.2.2: Geographical database, as procedure design is based on availability of quality assured geographical data.

Synchronization Needs

There is the need to coordinate/synchronize efforts (operational procedures, ground infrastructure and aircraft capabilities) between ANSPs and Airspace users to ensure the return of investment and/or the start of operational benefits. Coordination of deployment of PBN procedures is a local issue and must include all affected parties (ANSPs, airports, AUs and military authorities).

Civil / Military Coordination		
Coordination with military authorities (AU, ANSP, AD regulator) as required.		
Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users, Military Authorities (AU)	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B0-APTA Optimization of Approach Procedures including Vertical Guidance	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AOM-0602 Available AOM-0604 Available AOM-0605 SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	NAV10
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	RNP Approach shall be implemented at all runway ends except where local terrain, obstacles and/or environmental regulations preclude the implementation. The IP proposal should include a study/plan aimed at withdrawing existing non-precision approach procedures and the corresponding decommissioning of related nav-aids whilst considering transitional or contingency plans as required. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View. Due to the FOC of the Family 01/01/2021 and the rather tight schedule for implementing it on time, SDM recommends prioritizing the implementation of this Family in order to ensure the PCP implementation is achieved in due time.	

Family Deployment Approach[13]	The implementation of the Family would require the design of RNP APCH procedures for all runway ends if feasible; coordination with the Military Authority should be performed if deemed necessary **(MM1 – RNP APCH Procedure Design)**. Such procedures shall then be duly validated, and a safety assessment performed **(MM2 – RNP APCH Procedure Validation and safety assessment)**. Once the public consultation has been finalised in accordance to the local regulation **(MM3 – Public Consultation)**, all operational and technical staff involved shall be duly trained **(MM4 – Training)**. New procedures shall be submitted to the local NSA for operational approval **(MM5 – NSA operational approval)** and subsequently published for operational use **(MM6 – AIS Publication)**. The implementation project will be considered concluded with the start of permanent operational use **(MM7 – Implementation completed)**.

Family 1.2.2 – Geographic Database for Procedure design

1.2.2 – Geographic Database for Procedure design			
Main Sub-AF	S-AF 1.2 Enhanced Terminal Airspace using RNP-Based Operations		
Readiness for implementation	High		
Initial Operational Capability	01/01/2014	**Full Operational Capability**	01/01/2019

Description and Scope
Procurement/provision of geographic database to support procedure design including obstacle and terrain data as part of AIM. The availability of an up-to-date and quality assured geographic database (including the obstacle items and terrain data) of each TMA is a prerequisite to design new procedures such as RNP approaches. Geographical databases could be used by AUs to validate procedures with regards to performance for different aircraft types. PBN is based upon procedures involving geographical positions expressed in latitude and longitude rather than as locations relative to radio beacons placed on ground. A geographical point expressed in latitude and longitude can consist of up to 19 characters and hence carries a large amount of risk of input errors when handled manually. Procedures and functions must be in place to ensure that the full chain from the originator of the information (land surveyor) to the database in the procedure design tools, the AIM databases and the on-board navigation databases is such that no errors are introduced. Implementation of support procedures and functions to detect errors is one component in order to ensure the integrity of the data, and also a secure means for communicating the geographical data is fundamental. Manual handling of latitude/longitude and other navigation data is not acceptable as the risk of introduction of errors is too high.
Interdependencies
Exchange of geographical data is included in AIM that is supposed to be a service within SWIM (AF5).
Synchronization Needs
Prerequisite for 1.2.1, 1.2.3 and 1.2.4, as these Families include procedure design based on quality assured geographical data.
Civil / Military Coordination

[13] For further information concerning the mean duration of the Family implementation, please refer to the Short-Term Deployment Approach, as reported within Chapter 3.

Coordination with military as required.		
Stakeholders considered as gaps	ANSPs, Airport Operators	
Other stakeholders involved in the Family deployment	Military Authorities	
Links to ICAO GANP ASBUs	B0-APTA Optimization of Approach Procedures including Vertical Guidance	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AOM-0602 Available AOM-0604 Available
	ATM Master Plan Level 3 (Edition 2019)	NAV10, ITY-ADQ, INF07
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	The implementation of the Family would require the upgrade of the existing system and/or installation of the Database tool, which would also need the data exchange functions to be available. Such installation would require a final acceptance of the tool itself and the integration with other existing systems **(MM1 – Database tool created including data exchange functions)**, also taking into consideration that duly coordination with the Military Authority should be performed, as required. The Geographic Database shall be populated with the available geographical data, duly considering all the parameters to assure the quality of the data to be transferred **(MM2 – Database populated with quality assured data)**. Before the start of the operational use of the database, a safety assessment report shall be elaborated, delivered and approved **(MM3 – Safety Assessment)**, work procedures established and all the relevant staff shall be duly trained **(MM4 – Operational procedures established including training of staff)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.	

Family 1.2.3 – RNP1 Operations in high density TMAs (ground capabilities)

1.2.3 – RNP 1 Operations in high density TMAs (ground capabilities)			
Main Sub-AF	S-AF 1.2 Enhanced Terminal Airspace using RNP-Based Operations		
Readiness for implementation	High		
Initial Operational Capability	01/01/2015	**Full Operational Capability**	01/01/2024

Description and Scope

Implementation of RNP 1 departure routes, arrival routes and final approach transitions (SIDs, STARs, transitions) including the use of the Radius to Fix (RF) path terminator where benefits are enabled for noise exposure, emissions and/or flight efficiency (reducing environmental impact). The STAR including transitions and approach procedures shall form a continuous path down to the runway.

Required Navigation Performance (RNP) is a type of Performance Based Navigation (PBN) that allows an aircraft to fly a specific path between two defined points in space independently of terrestrial nav-aids placed along the route. RNP also requires monitoring and alerting capability on-board to safeguard the integrity of the position sensor.

As per definition, RNP 1 requires the Total System Error to remain within 1 NM either side of the intended flight path 95% of the time. This level of navigational accuracy together with the inherent integrity monitoring function offers a large potential for efficiency and capacity improvements by optimizing TMA airspace design accordingly. Current studies focus on TMA concepts with route spacing reduced to 7 NM.

Implementing stakeholders, primarily ANSPs and Airport Operators, are encouraged to implement airspace concepts taking advantage of the performance benefits offered through RNP; this may require the optimization or upgrades of existing support tools (MTCD, CDT, CORA) and safety nets (APW, STCA), or addition of new ones (related to primarily conformance monitoring). Stakeholders should consider the use of RF path terminator for accurate and repeatable turn execution.
Where continuity of conventional navigation means is required alongside RNP1, issues related to mixed mode of operation (could include military/state aircraft, non-equipped aircraft) must be taken into account.

As TMA operations become increasingly independent of conventional terrestrial nav-aids, such infrastructure, primarily VOR and NDB, should be considered for decommissioning. ANSPs shall ensure that their standing network of conventional nav-aids is sufficient to support an adequate contingency against GNSS outages, including a constellation level failure event. It is encouraged to seek cross-border agreements for better utilization of the remaining terrestrial infrastructure.

Interdependencies

Capability of ground systems and services should be synchronized with capability of aircraft and airspace users including military. PBN operations require availability of quality assured and accurate geographical data. See Family 1.2.2. The implementation of PBN/RNP in High-Density TMAs should be coordinated as needed with implementation of PBN/RNP in adjacent airspace covered by Extended AMAN supporting stable and efficient sequencing. See Families 1.1.2 and 1.2.5.

Synchronization Needs

The deployment of PBN in high density TMAs shall be synchronized due to the potential network performance impact of delayed implementation in the airports within the geographical scope of PCP. Synchronization of deployment is a local issue and must include all affected parties (ANSPs, airports, AUs and military).

From a technical perspective, the adjustment/upgrade of ATM systems and procedural changes shall be synchronized with civil and military aircraft capabilities in order to ensure that the performance objectives are met.

The synchronization of investments shall involve multiple airport operators ANSP and airspace users. Families 1.2.3, 1.2.4 and 1.2.5 should be coordinated and synchronized.

Civil / Military Coordination		
Coordination with military authorities (AUs, ANSP, AD, regulator) as required.		
Stakeholders considered as gaps	ANSPs, Airport Operators	
Other stakeholders involved in the Family deployment	Military Authorities	
Links to ICAO GANP ASBUs	B0-FRTO Improved Operations through Enhanced En-route Trajectories B1-FRTO Improved Operations through Optimized ATS Routing B1-RSEQ Improved Airport Operations through Departure, Surface and Arrival Management	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AOM-0603 SESAR Release 2 AOM-0605 SESAR Release 5 AOM-0602 Available AOM-0601 Available
	ATM Master Plan Level 3 (Edition 2019)	NAV03.1
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	It is recommended that implementation projects involve all major stakeholders concerning design, validation and public consultation of RNP1 procedures to achieve the full benefits. The IP proposal should include a study/plan for the rationalization of legacy nav-aid infrastructure whilst considering transitional or contingency plans as required. It is also recommended to take into consideration the results of Gap Analysis provided within the Monitoring View. Note that aircraft related projects concerning RNP outside the approach phase belong to Family 1.2.4.	
Family Deployment Approach	The implementation of the Family would require redesign of the existing terminal airspace with the objective to introduce RNP 1 and take advantage of its characteristics to optimize traffic patterns **(MM1 – Airspace Design completed)**. Moreover, RNP1 routes to and from all landing and departure runways where feasible shall be designed, duly validated and their safety appropriately assessed **(MM2 – RNP Procedure Design and validation and safety assessment)**. While performing such activities, it should be taken into consideration that the proper coordination with the Military Authority shall be performed, as required and a public consultation should be performed in accordance with local regulation **(MM3 – Public Consultation)**. The new airspace design including the RNP 1 routes shall then be submitted to the NSA for approval **(MM4 – NSA Operational Approval)**.	

	ATM system updates as required **(MM5 – ATM System updates)** and all operational and technical staff shall be appropriately trained **(MM6 – Training)**. RNP1 Routes shall then be published **(MM7 – RNP AIS Implementation (publication)**. The execution of implementation activities is expected to lead to the start of permanent operational use **(MM8 – Implementation completed)**.

Family 1.2.4 – RNP1 operations (aircraft capabilities)

1.2.4 – RNP 1 Operations (aircraft capabilities)			
Main Sub-AF	S-AF 1.2 Enhanced Terminal Airspace using RNP-Based Operations		
Readiness for implementation	High		
Initial Operational Capability	01/01/2015	**Full Operational Capability**	01/01/2024

Description and Scope
Implementation of aircraft PBN/RNP navigation capability with RF legs. This Family enables RNP 1 operations along departure (SID) and arrival (STAR) routes and ultimately on the route network connecting to En-Route airspace. Required Navigation Performance (RNP) is a type of Performance Based Navigation (PBN) that allows an aircraft to fly a specific path between two 3D-defined points in space. Most new transport aircraft delivered today are PBN/RNP capable, but operational usage requires flight crew training, documentation and approval. Retrofitting of transport-type military/state aircraft (including surveillance aircraft) and other PBN/RNP non-compliant aircraft might be required or incentivised, subject to positive CBA and their contribution to performance targets. Alternative military technical performance based equivalent means should also be considered where the appropriate certification processes are available.
Interdependencies
RNP operations rely on the appropriate PBN infrastructure deployed, as covered by families 1.2.1, 1.2.3 and in longer term, 1.2.5. PBN operations require availability of quality assured and accurate geographical data. See AF1, 1.2.2.
Synchronization Needs
The deployment of PBN in high density TMAs shall be coordinated due to the potential network performance impact of delayed implementation in the airports referred to in the geographical scope of PCP. Coordination of deployment of PBN procedures is a local issue and must include all affected parties (ANSPs, airports, AUs and military). Furthermore, it is recognized that a minimum "critical mass" of capable aircraft will be required for benefits stemming from PBN/RNP to materialize. From a technical perspective, the adjustment/upgrade of ATM systems and procedural changes shall be synchronized with aircraft capabilities in order to ensure that the performance objectives are timely met. The synchronization of investments shall involve multiple airport operators ANSP and airspace users.
Civil / Military Coordination
N/A

Stakeholders considered as gaps	Airspace Users, Military Authorities (AUs role)
Other stakeholders involved in the Family deployment	None

Links to ICAO GANP ASBUs	B0-FRTO Improved Operations through Enhanced En-route Trajectories B1-FRTO Improved Operations through Optimized ATS Routing B1-RSEQ Improved Airport Operations through Departure, Surface and Arrival Management	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AOM-0603 SESAR Release 2 AOM-0605 SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	NAV03.1
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	The implementation of the Family would require the commercial availability of a certified technical solution equipment **(MM1 – Availability of technical solutions for aircraft types in operation)**. Procurement of suitable equipment for the aircraft shall be completed **(MM2 – Equipment procured)**. Aircraft shall be equipped and flight crew shall be duly trained **(MM3 – Aircraft equipped and training of pilots)**. The execution of such activities is expected to lead the start of permanent operational use **(MM4 – Implementation completed)**.	

Family 1.2.5 – RNP routes connecting Free Route Airspace (FRA) with TMA

1.2.5 –RNP routes connecting Free Route Airspace (FRA) with TMA			
Main Sub-AF	S-AF 1.2 Enhanced TMA using RNP-Based Operations		
Readiness for implementation	Medium		
Initial Operational Capability	01/01/2020	**Full Operational Capability**	01/01/2024

Description and Scope
Connectivity between Free Route Airspace and TMAs through the implementation of RNP routes. The intention is to provide consistent PBN navigation capabilities from departure to landing. The most appropriate PBN type and navigation accuracy should be chosen depending on the local situation. Aircraft and crew need to be PBN capable and approved for all navigation specifications applicable to the different phases of flight. The availability of an Advanced RNP (A-RNP) certification specification enables the operators to seek a unified approval (covered by Family 1.2.4). Implementing stakeholders, primarily ANSPs, are encouraged to consider and implement airspace concepts that take advantage of the benefits conferred by A-RNP; primarily improved track keeping, inherent integrity monitoring and repeatable turn performance but also the optional functionalities proposed with A-RNP such as Fixed Radius Turn (FRT) and others. Emerging operational concepts make use of such functionalities. In a PBN environment, procedures should be in place to handle non-equipped aircraft. PBN route structure below FRA should be appropriately coordinated with NM according to the standard process for CACD database validation. Note: Advanced RNP is a recent addition to PBN and may undergo further evolution; this Family will be updated accordingly once the ICAO PBN Manual Edition 5 has been published.
Interdependencies
Family 1.1.2: AMAN upgrade to include Extended Horizon function. Family 1.2.3: RNP 1 Operations in high density TMAs. Family 1.2.4: RNP Operations (aircraft capabilities). Family 3.2.1: Upgrade of ATM systems (NM, ANSPs, AUs) to support Direct Routings (DCTs) and Free Routing Airspace (FRA). Family 3.2.4: Free Route Airspace.
Synchronization Needs
Implementation must be coordinated/synchronized between ground (PBN routes, operational procedures and upgrade of ATM systems as necessary), NM and aircraft capabilities to ensure optimum return of investment and realisation of operational benefits.
Civil / Military Coordination
Coordination with military authorities (AU, ANSP, AD regulator) as required.

Stakeholders considered as gaps	ANSPs, Network Manager, Military Authorities
Other stakeholders involved in the Family deployment	None

Links to ICAO GANP ASBUs	B0-FRTO Improved Operations through Enhanced En-route Trajectories B1-FRTO Improved Operations through Optimized ATS Routing	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AOM-0404 SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	None
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View. Note that aircraft related projects concerning RNP outside the approach phase belong to Family 1.2.4.	
Family Deployment Approach	The implementation of the Family would require the upgrade of the existing ATM systems and/or their installation. Such systems – Safety Nets being MTCD, STCA, CDT, CORA, APW, MSAW and FDP and CWP, etc – would also require the provision of their final acceptance and the integration with other existing systems, also considering that many of these components are already necessary for Family 3.2.1 **(MM1 – ATM systems upgrade)**. Advanced RNP routes below Free Route Airspace shall be designed, duly validated and their safety appropriately assessed, also coordinating such activities with NM and the Military Authority, as required **(MM2 – RNP Route Network Design, validation and safety assessment)**. In this respect, in order to accommodate a vertical profile, consideration should be given to the performance of representative aircraft and the effects produced by winds. Advanced RNP AIS procedures, including routes to and from all TMA entry/exit points, shall be published **(MM3 – RNP AIS Implementation (publication))** and all operational and technical staff shall be appropriately trained **(MM4 – Training)**. Finally, the finalized airspace design shall be submitted to the local NSA for approval. The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.	

4.2 AF #2 – Airport Integration and Throughput

Family 2.1.1 – Initial DMAN

2.1.1 – Initial DMAN			
Main Sub-AF	S-AF 2.1 Departure Management Synchronised with Pre-departure sequencing		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2021

Description and Scope

The aim of this Family is to implement Basic Departure Management (DMAN) functionalities to:

- ensure an efficient usage of the runway take off capacity by providing an optimum and context dependent queue at the holding points;
- improve the departure flows at airports;
- increase the predictability;
- calculate Target Take Off Times (TTOT) and the Target Start-up Approval Times (TSAT) taking into account multiple constraints and preferences out of the A-CDM processes;
- provide a planned departure sequence;
- reduce queuing at holding point and distribute the information to various stakeholders at the airport.

Operational stakeholders involved in A-CDM shall jointly establish pre-departure sequences, taking into account agreed principles to be applied for specific reasons, such as: runway holding time, slot adherence, departure routes, airspace user preferences, night curfew, evacuation of stand/gate for arriving aircraft, adverse conditions including de-icing, actual taxi/runway capacity, current constraints, inbound flights information, etc.

The departure sequence at the runway shall be optimized according to the real traffic situation reflecting any relevant change off-gate or during taxi to the runway. DMAN systems shall take account of variable and updated taxi times (ref Family 2.4.1) to calculate the TTOT and TSAT.

Interdependencies

Family 2.1.2 Digital systems such as Electronic Flight Strips (EFS) or strip less systems: Digital systems such as Electronic Flight Strips (EFS) or strip less systems are a necessary enabler to support the DMAN functionality. It allows to have accurate information such as TSAT and TOBT TTOT which have a high update frequency. Family 2.1.3 A-CDM: A-CDM combined with Initial DMAN establishes the foundations of the collaboration among stakeholders: procedures and information (such as TOBT and TSAT).

Family 2.2.1 A-SMGCS level 1-2: Initial DMAN is one of the four elements, together with digital systems such as Electronic Flight Strips (EFS) or strip less systems, A-SMGCS level 1-2 and A-SMGCS Routing and Planning Functions which contribute to implement the Sub ATM Functionality: "Departure Management integrating Surface Management Constraints".

Family 2.4.1 A-SMGCS Routing and Planning Functions: Initial DMAN is one of the four elements, together with digital systems such as Electronic Flight Strips (EFS) or strip less systems, A-SMGCS level 1-2 and A-SMGCS Routing and Planning Functions which contribute to implement the Sub ATM Functionality: "Departure Management integrating Surface Management Constraints".

Synchronization Needs

ANSPs, Airport Operators, Ground Handling Companies and Airspace Users synchronization is needed for the implementation of the Family.

Where relevant, synchronisation between ANSPs, and Airport Operators is needed for Family: 2.1.2, 2.1.4, 2.2.1 and 2.4.1.

Synchronisation between ANSPs, Airport Operators, Ground Handling Companies, Airspace Users and Network Manager is needed for Family: 2.1.3.

Civil / Military Coordination		
Applicable to those airports mentioned in the PCP and open to civil and military operations		
Stakeholders considered as gaps	ANSPs, Airport Operators	
Other stakeholders involved in the Family deployment	Airspace Users, Military Authorities, Ground Handling Companies	
Links to ICAO GANP ASBUs	B0-RSEQ (Improved Traffic Flow through Sequencing (AMAN/DMAN) B1-RSEQ Improved Airport Operations through Departure, Surface and Arrival Management	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AO-0602 Available
	ATM Master Plan Level 3 (Edition 2019)	AOP05
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	It is recommended to take into consideration the three following elements of S-AF2.1: Family 2.1.1, Family 2.1.3 and Family 2.1.4 which are necessary to achieve the "Departure Management Synchronised with Pre-departure sequencing". It is further recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	The implementation of the Family would require the DMAN system to implement Target Take Off Time (TTOT) & Target Startup Approval Time (TSAT) **(MM1 – System implemented for TTOT and TSAT)** according to PDS principles, also taking into consideration all necessary constraints (such as runway holding time, slot adherence, departure routes, airspace user preferences, night curfew, evacuation of stand/gate for arriving aircraft, adverse conditions including de-icing, actual taxi/runway capacity, current constraints, inbound flights information, etc.). Such system shall then be integrated in the local environment with the digital systems, updated as well in order to properly support the DMAN **(MM2 – Integration in local environment with digital systems such as Electronic Flight Strips (EFS) or strip less systems)**. Before the start of the operational use, DMAN operational procedures shall be elaborated and then published **(MM3 – Operational Procedures)**, all relevant staff shall be duly trained **(MM4 – Training)**, a safety assessment successfully performed and contextual report shall be made available **(MM5 – Safety assessment)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM6 – Implementation completed)**.	

Family 2.1.2 – Digital systems such as Electronic Flight Strips (EFS) or strip less systems

2.1.2 – Digital systems such as Electronic Flight Strips (EFS) or strip less systems			
Main Sub-AF	S-AF2.1 Departure Management Synchronised with Pre-departure sequencing		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2021

Description and Scope

The operational context of digital systems such as Electronic Flight Strips (EFS) or strip less systems is the automated assistance to tower controller and where appropriate also approach and ground controller as well as the automated information exchange within and between these units. The system permits controllers to conduct real-time, screen to screen coordination within their unit and with "neighbouring" units in the process chain reducing workload associated with coordination, integration and identification tasks. The system supports coordination dialogue between controllers and transfer of flights between units or different locations within one unit (e.g. multiple Ground Control Towers at big airports) and facilitates early resolution of conflicts through automated coordination.

Digital systems such as Electronic Flight Strips (EFS) or strip less systems shall integrate the instructions given by the air traffic controller with other data such as flight plan, surveillance, routing, published rules and procedures.

Digital systems such as Electronic Flight Strips (EFS) or strip less systems can support the controller to manage constraints related to the surface route trajectories using A-SMGCS.

Digital systems such as Electronic Flight Strips (EFS) or strip less systems can support the necessary electronic real-time information sharing between systems from the Tower Runway Control to the Final Approach Control. These systems are the TBS support tool and AMAN. Digital systems such as Electronic Flight Strips (EFS) or strip less systems shall support Airport Safety Nets.

Interdependencies

Family 2.1.1 Initial DMAN: digital systems such as Electronic Flight Strips (EFS) or strip less systems are necessary enablers to support the DMAN functionality. It allows to have accurate information such as TSAT and TOBT TTOT which have a high update frequency. Family 2.4.1 A-SMGCS Planning and Routing Functions: Considering A-SMGCS Level 1 and 2 as a prerequisite for all following A-SMGCS services, it is suggested that implementers take account of the need for implementing digital systems such as Electronic Flight Strips (EFS) or strip less systems and linking their functionalities to the A-SMGCS Level 1 & 2 and higher functions.

Family 2.3.1 TBS: digital systems such as Electronic Flight Strips (EFS)or strip less systems are necessary to support TBS functionality. It allows to share accurate information such as air traffic control instructions into the ATM system.

Family 1.1.1 Basic AMAN is linked by the integration of AMAN information in the digital systems such as Electronic Flight Strips (EFS) or strip less systems.

Family 1.1.2 AMAN Upgrade to include Extended Horizon function is linked by the integration of Extended AMAN information in the digital systems such as Electronic Flight Strips (EFS) or strip less systems.

Synchronization Needs

ANSPs, and Airport Operators when relevant.

Civil / Military Coordination

Applicable to those airports mentioned in the PCP and open to civil and military operations

Stakeholders considered as gaps	ANSPs, Airport Operators	
Other stakeholders involved in the Family deployment	Military Authorities	
Links to ICAO GANP ASBUs	None	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AO-0201 (only AERODROME-ATC-36 enabler) Available
	ATM Master Plan Level 3 (Edition 2019)	AOP12
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	This Family 2.1.2 is a prerequisite for Families 2.4.1, 2.5.1 & 2.5.2, and could be seen as an enabler for Families 2.2.1 and 2.3.1. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	The deployment of the Family would require the implementation of the digital systems such as Electronic Flight Strips (EFS) or strip less systems in the tower; dedicated digital systems such as Electronic Flight Strips (EFS) or strip less systems shall also be installed in the apron and approach positions for the relevant airports **(MM1 – System support to basic procedures)**. In order for the system to be properly implemented, digital systems such as Electronic Flight Strips (EFS) or strip less system Operational Procedures shall be elaborated and subsequently published **(MM2 – Operational Procedures)**, all relevant staff shall be duly trained **(MM3 – Training)**, a safety assessment shall be successfully performed and contextual report shall be made available **(MM4 – Safety assessment)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.	

Family 2.1.3 – Basic A-CDM

2.1.3 – Basic A-CDM			
Main Sub-AF	S-AF 2.1 Departure Management Synchronised with Pre-departure sequencing		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2021

Description and Scope

A-CDM is the concept, which aims at improving operational efficiency at airports and improves their integration into the Air Traffic Flow and Capacity Management (ATFCM) by increasing information sharing and improving cooperation between all relevant stakeholders (local ANSP, airport operator, aircraft operators, NM, other airport service providers).

Those elements allow the airport partners to achieve a common situational awareness and improve traffic event predictability. The Airport CDM concept is built on the following elements:

- Information Sharing. The Information Sharing CDM element defines the sharing of accurate and timely information, as well as the performance objectives and KPIs, between the Airport CDM Partners. Local procedures will/can be defined and implemented according to Letters of Agreement (LoAs) and/or Memorandum of Understanding (MoU).
- Milestone Approach. The Milestone Approach CDM element describes the progress of a flight from the initial planning to the take off by defining key Milestones to enable close monitoring of significant events.
- Variable Taxi Time. The Variable Taxi Time element consists of calculating and distributing to the Airport CDM partners accurate estimates of taxi-in and taxi-out times to improve the estimates of in-block and take off times and thus to increase the quality of the departure sequence.
- Adverse conditions management allows improving the resilience of airports. An Initial Airport Operations Centre can be implemented to support these elements to reinforce the collaborative decision-making process with all stakeholders. The Initial Airport Operations Centre assesses the global performance of the airport, and facilitates the Demand and Capacity Balancing monitoring.
- Once A-CDM has been implemented locally, airport shall implement flight update messages (FUM) and Departure Planning Information (DPI). This last A-CDM element strengthens the link with the ATMN, facilitates the flow and capacity management and increases predictability as well as increases efficiency at the network level.

Interdependencies

Family 2.1.1 Initial DMAN: A-CDM combined with Initial DMAN establishes the foundations of the collaboration among stakeholders: procedures and information (such as TOBT and TSAT).

Family 2.1.4 Initial AOP: A-CDM defines the baseline processes for sharing information which are stored in the Airport Operations Plan.

Family 4.2.4 AOP/NOP Information Sharing requires the integration of the basic A-CDM for defining exchanges of DPI, FUM and Extended messages.

Family 5.5.1 Upgrade / Implement Cooperative Network Information Exchange System / Service will support the AOP/NOP Information Sharing exchanges: DPI and FUM messages.

Family 5.6.1 Flight Information System / Service in support of A-CDM and iAOP will support the AOP/NOP Information Sharing exchanges: DPI and FUM messages.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Family 5.5.1 and 5.6.1 services as listed in the Appendix 1 of this Chapter.

Synchronization Needs
ANSPs, Airport Operators, Ground Handling Companies, Airspace Users and Network Manager synchronization is needed for the implementation of the Family. Synchronisation between ANSPs, Airport Operators, Ground Handling Companies, Airspace Users and Network Manager is needed for Family: 2.1.1. Where relevant, synchronisation between ANSPs, and Airport Operators is needed for Family: 2.1.4 Synchronisation between ANSPs, Airport Operators, and Network Manager is needed for Families: 4.2.4, 5.5.1 and 5.6.1.
Civil / Military Coordination
Applicable to those airports mentioned in the PCP and open to civil and military operations

Stakeholders considered as gaps	ANSPs, Airport Operators	
Other stakeholders involved in the Family deployment	Airspace Users, Network Manager, Military Authorities, Ground Handling Companies	
Links to ICAO GANP ASBUs	B0-ACDM Improved Airport Operations through Airport-CDM B1-ACDM Optimized Airport Operations through A-CDM Total Airport Management B1-AMET Enhanced Operational Decisions through Integrated Meteorological Information (Planning and Near-term Service) B1-NOPS Enhanced Flow Performance through Network Operational Planning	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AO-0501 Available AO-0601 Available AO-0602 Available AO-0603 Available
	ATM Master Plan Level 3 (Edition 2019)	AOP05
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	It is recommended to take into consideration the three following elements of S-AF2.1: F211, F213 and F214 which are necessary to achieve the "Departure Management Synchronised with Pre-departure sequencing". SDM therefore strongly recommends that all projects related to Basic A-CDM shall be completed as early as possible before the defined FOC Date of the Sub-AF to allow for the deployment of subsequent solutions. It is recommended to implement Family 2.1.3 as soon as possible since Airport CDM is part of the critical initiatives to resolve and mitigate the impacts of current capacity constraints and potential bottlenecks, which might hinder the overall performance at network level.	

	It is recommended liaising between different stakeholders (both within the same stakeholder category and between different categories) to draft and present joint proposals in the framework of upcoming Calls. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.
Family Deployment Approach	The implementation of the Family would require conducting an information sharing process in order to allow the airport and local partners after signature of an MOU to achieve a common situational awareness **(MM1 – Information sharing)**. Basic A-CDM implementation shall further be supported by the execution of all the elements of the A-CDM "Milestone Approach" described in the CDM Manual **(MM2 – A-CDM "Milestone Approach")**, in conjunction with the fulfilment of all the elements of the "variabtimes", described in the A-CDM Manual as well **(MM3 – Variable taxi-times implementation)**. Furthermore, all measures whose implementation allows the mitigation of adverse situations (initial APOC, CDM cell, etc) shall be put into use **(MM4 – Adverse conditions implementation)**. Following the implementation of all elements of the "Flight Update Message" described in the CDM Manual and the FUM Implementation Guide **(MM5 – FUM Implementation)**, the application of all elements of the "Departure Planning Information" messages reported on the CDM Manual and the DPI Implementation Guide shall be performed **(MM6 – DPI Implementation)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM7 – Implementation completed)**.

Family 2.1.4 – Initial Airport Operations Plan (AOP)

2.1.4 – Initial Airport Operations Plan (AOP)			
Main Sub-AF	S-AF 2.1 Departure Management Synchronised with Pre-departure sequencing		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2021

Description and Scope

The Airport element that reflects the operational status of the Airport and therefore facilitates Demand and Capacity Balancing is the Airport Operations Plan (AOP). The AOP connects the relevant stakeholders, notably the Airspace Users' Flight Operations Centre (FOC).

It contains data and information relating to the different status of planning phases and is in the format of a rolling plan, which naturally evolves over time. The AOP is a single, common and collaboratively agreed rolling plan available to all airport stakeholders whose purpose is to provide common situational awareness and to form the basis upon which stakeholder decisions relating to process optimization can be made. The ATM stakeholders' planning processes and working methods are included in the AOP.

The AOP contains elements such as KPIs and alerts, which allow monitoring and assessing the performance of A-CDM operations. Most of the data involved in the AOP implementation is currently shared among local stakeholders and where available, through the A-CDM process.

The initial AOP is the local airport part of the AOP. The following data have to be implemented:

- Flight trajectory data: Information sharing related to Flight Progress Information Elements of an Inbound/Outbound/Airport transit Trajectory to/from/at Airport.
- Airport Resources data: Airside and Landside resources such as runway capacity & configuration, or parking stands.
- Local weather data: Information sharing related to MET Information Elements of airport.

There are also strong interdependencies with S-AF4.2 Collaborative NOP as well as with S-AF5.5 Cooperative Network Information Exchange. The initial AOP shares information with the NOP which provides a rolling picture of the network situation used by stakeholders to prepare their plans and their inputs to the network CDM processes (e.g. negotiation of airspace configurations). NM Information will be freely exchanged by Operational stakeholders by means of defined cooperative network information services, using the yellow SWIM Technical Infrastructure Profile.

Interdependencies

Family 2.1.3 Basic A-CDM: A-CDM defines the processes for sharing information which are stored in the Airport Operations Plan.

Interface and data Requirements of AF4 NOP and of A-CDM.

Family 4.2.4 AOP/NOP Information Sharing requires the integration of the initial AOP: the full AOP implementation requires synchronisation with the NOP (see AF4 "interactive Rolling NOP"). The implementation of this synchronisation is targeted by Family 4.2.4 "*AOP/NOP information sharing*" for extending the A-CDM information sharing.

Family 5.3.1 Aeronautical Information Exchange / Service will be used in the initial AOP.

Family 5.4.1 Upgrade / Implement Meteorological Information Exchange System / Service will be used in the initial AOP in support of weather information.

Family 5.5.1 Upgrade / Implement Cooperative Network Information Exchange System / Service will support the initial AOP.

Family 5.6.1 Flight Information System / Service will support the initial AOP in support of A-CDM.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Family 5.3.1, 5.4.1, 5.5.1 and 5.6.1 services as listed in the Appendix 1 of this Chapter.

Synchronization Needs		
ANSPs, Airport Operators, Airspace users when relevant synchronization is needed for the implementation of the Family. Synchronisation between ANSPs, Airport Operators and Airspace Users is needed for Family: 2.1.3. Synchronisation between ANSPs, Airport Operators and Network Manager is needed for Family: 2.1.1, 4.2.4, 5.5.1 and 5.6.1.		
Civil / Military Coordination		
Applicable to those airports mentioned in the PCP and open to civil and military operations.		
Stakeholders considered as gaps	ANSPs, Airport Operators	
Other stakeholders involved in the Family deployment	Airspace Users, Military Authorities, Network Manager, MET Service Providers	
Links to ICAO GANP ASBUs	B1-ACDM Optimized Airport Operations through A-CDM Total Airport Management B1-AMET Enhanced Operational Decisions through Integrated Meteorological Information (Planning and Near-term Service) B1-RSEQ Improved Airport Operations through Departure, Surface and Arrival Management	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AO-0801-A (AIRPORT-03) SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	AOP11
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Family 2.1.4 can be considered as prerequisite to Family 4.2.4, hence should be implemented as soon as possible not waiting for Family 4.2.4 to be ready/completed. Family 2.1.4 can also be seen as an extension of the Airport Operational Database. It is recommended to take into consideration the three following elements of S-AF2.1: F211, F213 and F214 which are necessary to achieve the "Departure Management Synchronised with Pre-departure sequencing". It is recommended to implement Family 2.1.4 as soon as possible since Initial AOP is part of the critical initiatives to resolve and mitigate the impacts of current capacity constraints and potential bottlenecks, which might hinder the overall performance at network level. It is recommended liaising between different stakeholders (both within the same stakeholder category and between different categories) to draft and present joint proposals in the framework of upcoming Calls. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View. Due to the FOC of Family 2.1.4 being 01/01/2021 and the rather tight schedule for implementing it on time, SDM recommends prioritizing the implementation of this Family at PCP airports to ensure the PCP implementation is achieved in due time.	

Family Deployment Approach[14]	The implementation of the Family would require the process of information sharing related to Flight Progress Information Elements of an inbound / outbound airport transit Trajectory to / from / at the airport, as described in the OFA 05.01.01 document **(MM1 – Flight trajectory data implementation)**. The Initial Airport Operations Plan (AOP) deployment would also need the installation of the necessary airside and landside resources, such as runway capacity, runway configuration and parking stands **(MM2 – Airport resources data implementation)**. Moreover, and information sharing process related to MET Information Elements of Airport, as outlined in the OFA 05.01.01 document, shall be duly performed **(MM3 – Local weather data implementation)**. All relevant staff shall be duly trained (**MM4 – Training**), The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.

[14] For further information concerning the mean duration of the Family implementation, please refer to the Short-Term Deployment Approach, as reported within Chapter 3.

Family 2.2.1 – A-SMGCS level 1 and 2

2.2.1 – A-SMGCS Level 1 and 2			
Main Sub-AF	S-AF 2.2 DMAN Integrating Surface Management Constraints		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2021

Description and Scope

Advanced Surface Movement Guidance and Control System (A-SMGCS) is providing aerodrome surveillance as well as planning, routing and guidance for the control of aircraft and vehicles in order to maintain the declared surface movement rate under all weather conditions within the aerodrome visibility operational level (AVOL) while maintaining the required level of safety.

A-SMGCS level 1 provides ATC with the position and identity of:

- All relevant aircraft within the movement area.
- All relevant vehicles within the manoeuvring area.

Traffic will be controlled through the use of appropriate procedures allowing the issuance of information and clearances to traffic on the basis of A-SMGCS level 1 surveillance data.

A-SMGCS level 2 is a level 1 system complemented by the A-SMGCS function to detect potential conflicts on runways, taxiways and intrusions into restricted areas and provide the controllers with appropriate alerts. A-SMGCS integrates all surface information sources enhancing situational awareness. A-SMGCS level 1 is a prerequisite for A-SMGCS level 2 and all higher A-SMGCS functions.

Interdependencies

S-AF 2.4, A-SMGCS Level 1 is a prerequisite for Family 2.4.1:

- Airport Conformance Monitoring shall integrate A-SMGCS Surveillance data (Family 2.2.1), Surface Movement Routing and Planning (Family 2.4.1) and controller routing clearances.
- When relevant, A-SMGCS shall include the advanced routing and planning function referred to in Sub-AF 2.4 to enable conformance monitoring alerts.
- A-SMGCS shall provide -optimized taxi-time and improve predictability of take-off times by monitoring of real surface traffic and by considering updated taxi times in departure management regardless of meteorological or other impacting conditions.

S-AF 2.5, A-SMGCS Level 1 and 2 is a prerequisite for Family 2.5.1:

- Airport Conformance Monitoring shall integrate A-SMGCS Surveillance data (Family 2.2.1), Surface Movement Routing and Planning (Family 2.4.1) and controller routing clearances.
- A-SMGCS shall include a function to generate and distribute the appropriate alerts. These alerts shall be implemented as an additional layer on top of the existing A-SMGCS level 2 alerts and not as a replacement of them.

Synchronization Needs

Depending on local airport specificities and relationship among local ANSPs and Airport Operators, planning and the realisation of implementation of A-SMGCS Level 1 & 2 must be synchronised. Examples of areas where synchronisation is needed are: building development and/or improvement for surveillance radar, cabling and/or power supply for Air Traffic Control A-SMGCS screens and devices, cabling for MLAT or other on-the-filed supporting systems, etc.

In relationship with the fact that A-SMGCS Level 1 is a prerequisites for all higher A-SMGCS Functions, should Initial DMAN and Basic A-CDM be implemented or planned to be implemented and, depending on local airport specificities and relationship among local ANSPs, Airport Operators, Handling Agents, Aircraft Operators and Meteorological Office (plus Military Authorities where relevant), planning and the realisation of the implementation of A-SMGCS Level 1 & 2 in relationship with the implementation of Initial DMAN and Basic A-CDM should be synchronised where relevant.

Civil / Military Coordination		
Applicable to those airports mentioned in the PCP and open to civil and military operations		
Stakeholders considered as gaps	ANSPs, Airport Operators	
Other stakeholders involved in the Family deployment	Military Authorities	
Links to ICAO GANP ASBUs	B0-ASUR Initial Capability for Ground Surveillance B0-SURF Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2) B1-RSEQ Improved Airport Operations through Departure, Surface and Arrival Management	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AO-0201 Available AO-0102 Available
	ATM Master Plan Level 3 (Edition 2019)	AOP04.1, AOP04.2
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Family 2.2.1 is a prerequisite for further deployment, especially in Sub-AF 2.4 and 2.5. SDM therefore strongly recommends that all projects related to A-SMGCS Level 1 and 2 shall be completed as early as possible before the defined FOC Date of the Sub-AF to allow for the deployment of subsequent solutions. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View. Due to the FOC of Family 2.2.1 being 01/01/2021 and the rather tight schedule for implementing it on time, SDM recommends prioritizing the implementation of this Family at PCP airports to ensure the PCP implementation is achieved in due time.	
Family Deployment Approach[15]	The implementation of the Family would require the installation of the A-SMGCS Level 1 background systems (e.g. surface movement radar(s), multilateration, etc.) **(MM1 – A-SMGCS Level 1 installation)**, which shall be complemented by the set-up of the A-SMGCS Level 2 system, the RIMCAS, also including the equipage of the relevant vehicles with transponders **(MM2 – A-SMGCS Level 2 installation)**. Before the start of the operational use, A-SMGCS Level 1 and 2 Operational Procedures shall be elaborated and then published **(MM3 – Operational Procedures)**, all relevant staff shall be duly trained **(MM4 – Training)**, a safety assessment shall be successfully performed and contextual report shall be made available **(MM5 – Safety Assessment)**.	

[15] For further information concerning the mean duration of the Family implementation, please refer to the Short-Term Deployment Approach, as reported within Chapter 3.

	The execution of such activities is expected to lead to the start of permanent operational use **(MM6 – Implementation completed)**.

Family 2.3.1 – Time Based Separation (TBS)

2.3.1 – Time Based Separation (TBS)			
Main Sub-AF	S-AF2.3 Time Based Separation for Final Approach		
Readiness for implementation	High		
Initial Operational Capability	01/01/2015	**Full Operational Capability**	01/01/2024

Description and Scope

Time Based Separation (TBS) consists in the separation of aircraft in sequence on the approach to a runway using time intervals instead of distances. It may be applied during final approach by allowing equivalent distance information to be displayed to the controller taking account of prevailing wind conditions. Radar separation minima and Wake Turbulence Separation parameters shall be integrated in a TBS support tool providing guidance to the air traffic controller to enable time-based spacing of aircraft during final approach that considers the effect of the headwind. The TBS support tool shall integrate an automatic monitoring and alerting of separation infringement safety net.

The objective is to recover loss in airport arrival capacity currently experienced in headwind conditions on final approach under distance-based wake turbulence radar separation rules. By using time-based parameters, this loss is mitigated, having a positive effect on runway throughput and runway queuing delays. Minimum radar separation is not affected.

Whilst TBS operations are not exclusive to a headwind on final approach, the current deployment proposal is specifically targeted at realizing the potential capacity benefits in these currently constraining conditions.

Radar separation minimum and new wake-vortex separation standards (such as RECAT) shall be integrated in the Time-Based Separation support tool that provide guidance to the controller to achieve the time proposed spacing to counter the effect of the headwind.

Where available, ensure local MET info with actual glide-slope wind conditions are provided to the TBS Support tool. When relevant, ensure the AMAN system is compatible with the TBS support tool.

Interdependencies

Family 1.1.1 Basic AMAN is linked by the integration of TBS information in the AMAN.

Family 1.1.2 AMAN Upgrade to include Extended Horizon Function is linked by the integration of TBS information in the AMAN.

Family 2.1.2 Digital systems such as Electronic Flight Strips (EFS) or strip less systems are necessary to support the TBS functionality. It allows to share accurate information such as air traffic control instructions into the ATM system.

Family 5.4.1 Meteorological Information Exchange will feed the time-based separation. Family 2.1.4 Initial AOP for Meteorological Information, if Family 5.4.1 is not implemented/available.

Synchronization Needs

Depending on local airport specificities and relationship among local ANSPs, Met Office, Aircraft Operators and Airport Operators, all must synchronize themselves through the planning and the realization of the implementation of Family 2.3.1 TBS. Air Navigation Service Providers need to be able to use other meteorological sources where available and which provide at least the same accuracy.

In relationship with the fact that TBS will benefit from Families 1.1.1 and 1.1.2 information input, real time and forecasted Met information input (Families 214 and/or 241), using digital systems such as Electronic Flight Strips (EFS) or strip less systems or equivalent will ensure enough system integration to ensure efficient TBS operations. Therefore, the need for inter families' coordination and synchronization is necessary through the planning and the realization of the implementation of TBS.		
Civil / Military Coordination		
Applicable to those airports mentioned in the PCP and open to civil and military operations		
Stakeholders considered as gaps	ANSPs, Airport Operators	
Other stakeholders involved in the Family deployment	Airspace Users, Military Authorities	
Links to ICAO GANP ASBUs	B1-AMET Enhanced Operational Decisions through Integrated Meteorological Information (Planning and Near-term Service) B2-WAKE Advanced Wake Turbulence Separation (Time-based)	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AO-0303 SESAR Release 2
	ATM Master Plan Level 3 (Edition 2019)	AOP10
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	It is recommended to implement Family 2.3.1 as soon as possible since TBS is part of the critical initiatives to resolve and mitigate the impacts of current capacity constraints and potential bottlenecks, which might hinder the overall performance at network level. It is recommended liaising between different stakeholders (both within the same stakeholder category and between different categories) to draft and present joint proposals in the framework of upcoming Calls. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	The implementation of the Family would require the integration of the Time-Based Separation (TBS) tool in the local environment (including necessary upgrades for other systems, e.g. AMAN, digital systems such as Electronic Flight Strips (EFS) or strip less systems, etc.). The AMAN system compatibility with the TBS support tool shall be ensured; CWP shall be modified in order to integrate the tool with the safety net; wind conditions shall be provided to the tool as well as automatic monitoring and alerting **(MM1 – Integration in local environment)**. Before the start of operational use of the tool, TBS Operational Procedures shall be elaborated and subsequently published **(MM2 – Operational Procedures)**, Air Traffic Controller and Flight Crews shall be duly trained **(MM3 – Training)**, a safety assessment shall be successfully performed and contextual report shall be made available **(MM4 – Safety Assessment)**.	

	The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.

Family 2.4.1 – A-SMGCS Routing and Planning Functions

2.4.1 – A-SMGCS Routing and Planning Functions			
Main Sub-AF	S-AF 2.4 Automated Assistance to Controller for Surface Movement Planning and Routing		
Readiness for implementation	High		
Initial Operational Capability	01/01/2016	**Full Operational Capability**	01/01/2024

Description and Scope

Advanced Surface Movement Guidance and Control System (A-SMGCS) is providing aerodrome surveillance as well as routing and planning, guidance for the control of aircraft and vehicles in order to maintain the declared surface movement rate under all weather conditions within the aerodrome visibility operational level (AVOL) while maintaining the required level of safety.

A-SMGCS Routing and Planning Functions provide ATC with:

- Optimized route designation for each aircraft or vehicle within the movement area;
- The detection of all route conflicts on the movement area as well as improved routing and planning for use by controllers.

Traffic will be controlled through the use of appropriate procedures allowing the issuance of information and clearances to traffic. A-SMGCS Level 1 is a prerequisite to A-SMGCS Routing and Planning Functions.

Ref S-AF 2.2, 2.4 and 2.5:

- Interfaces between DMAN and A-SMGCS shall be developed with the purpose to integrate departure sequencing and routing computation.
- Digital systems such as Electronic Flight Strips (EFS) or strip less systems, with an advanced A-SMGCS routing function, shall be integrated into the flight data processing system.
- The routing and planning functions of A-SMGCS shall provide the automatic generation of taxi routes, with the corresponding estimated taxi time and management of potential conflicts. Taxi routes may be manually modified by the air traffic controller before being assigned to aircraft and vehicles. These routes shall be available in the flight data processing system.
- The A-SMGCS routing and planning function shall calculate the most operationally relevant route as free as possible of conflicts which permits the aircraft to go from stand to runway, from runway to stand or any other surface movement. The controller working position shall allow the air traffic controller to manage surface route trajectories. The flight data processing system shall be able to receive planned and cleared routes assigned to aircraft and vehicles and manage the status of the route for all concerned aircraft and vehicles.
- A-SMGCS Routing and Planning Functions shall integrate all surface information sources, enhance situational awareness and provide the controllers with appropriate alerts.
- Digital systems, such as Electronic Flight Strips (EFS) or strip less systems, shall integrate the instructions given by the air traffic controller with other data such as flight plan, surveillance, routing, published rules and procedures.

A-SMGCS shall include the advanced routing and planning function to enable conformance monitoring alerts.

Interdependencies

Family 2.1.1 Initial DMAN: Considering A-SMGCS Level 1 and 2 as a prerequisite for all higher A-SMGCS functions, it is suggested that implementers take account of the need for implementing Initial DMAN and linking its functionalities to the A-SMGCS functions.

Family 2.1.2 Digital systems such as Electronic Flight Strips (EFS) or strip less systems: Considering A-SMGCS Level 1 and 2 as a prerequisite for all higher A-SMGCS functions, it is suggested that implementers take account of the need for implementing digital systems such as Electronic Flight Strips (EFS) or strip less systems and linking its functionalities to the A-SMGCS Level 1 & 2 and higher functions where it is considered as a prerequisite.

S-AF 2.4, since A-SMGCS Level 1 is a prerequisite for Family 2.4.1:

- Airport Conformance Monitoring shall integrate A-SMGCS Surveillance data (Family 2.2.1), Surface Movement Routing and Planning (Family 2.4.1) and controller routing clearances.
- When relevant, A-SMGCS shall include the advanced routing and planning function referred to in Sub-AF 2.4 to enable conformance monitoring alerts.
- A-SMGCS shall provide -optimized taxi-time and improve predictability of take-off times by monitoring of real surface traffic and by considering updated taxi times in departure management regardless of meteorological or other impacting conditions.

S-AF 2.5, since A-SMGCS Level 1 and 2 is a prerequisite for Family 2.4.1:

- Airport Conformance Monitoring shall integrate A-SMGCS Surveillance data (Family 2.2.1), Surface Movement Routing and Planning (Family 2.4.1) and controller routing clearances.
- A-SMGCS shall include a function to generate and distribute the appropriate alerts. These alerts shall be implemented as an additional layer on top of the existing A-SMGCS level 2 alerts and not as a replacement of them.

Synchronization Needs

Depending on local airport specificities and relationship among local ANSPs, Aircraft Operators and Airport Operators, planning and realisation of the implementation of Family 2.4.1 must be synchronised.

In relationship with the fact that some functionalities of Family 2.4.1 are prerequisites for Sub-AF 2.5 Families, depending on local airport specificities and relationship among local ANSPs and Airport Operators, both should synchronize themselves when relevant, through the planning and the realisation of the implementation of Family 2.4.1 in relationship with the implementation of Families 212, 221, 2.5.1 and 2.5.2 (Part A).

Civil / Military Coordination

Applicable to those airports mentioned in the PCP and open to civil and military operations

Stakeholders considered as gaps	ANSPs, Airport Operators	
Other stakeholders involved in the Family deployment	Ground Handling Companies, Aircraft Operators, Military Authorities	
Links to ICAO GANP ASBUs	B1-RSEQ Improved Airport Operations through Departure, Surface and Arrival Management B2-SURF Optimized Surface Routing and Safety Benefits (A-SMGCS Level 3-4 and SVS)	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AO-0205 SESAR Release 5 TS-0201 SESAR Release 1 TS-0202 SESAR Release 4
	ATM Master Plan Level 3 (Edition 2019)	AOP13 AOP16
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Some functionalities of Families 2.5.1 and 2.5.2 depend on the implementation of A-SMGCS Routing and Planning Functions (Family 2.4.1) which has a later FOC date (01/01/2024).	

	Where necessary it is therefore recommended to synchronize Families 2.5.1 and 2.5.2 with Family 2.4.1 or to integrate those relevant functionalities in the respective 2.4.1 IP. It is recommended liaising between different stakeholders (both within the same stakeholder category and between different categories) to draft and present joint proposals in the framework of upcoming Calls. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View. Hence, some elements of Family 2.4.1 "A-SMGCS Routing and Planning Functionalities" being essential prerequisites to implement Families 2.5.1 and 2.5.2, plus taking account of the estimated typical duration to implement the Family 2.4.1 and of the rather tight schedule for implementing Families 2.5.1 and 2.5.2 on time (FOC 01/01/2021), SDM recommends prioritizing the implementation of Family 2.4.1 at PCP airports to ensure the PCP implementation is achieved in due time.
Family Deployment Approach[16]	The implementation of the Family would require the upgrade of the A-SMGCS routing and planning functions in order to support taxi route clearance modified by ATCOs (Sub-AF 2.4); the interface between DMAN and A-SMGCS routing functions shall be developed and also the identification of mobiles (aircraft and vehicles) shall be ensured **(MM1 – Installation and integration in local environment with A-SMGCS, digital systems such as Electronic Flight Strips (EFS) or strip less systems and DMAN)**. Before the start of the operational use, A-SMGCS Planning and Routing Operational Procedures shall be elaborated and then published **(MM2 – Operational Procedures)**, all relevant staff shall be duly trained **(MM3 – Training)**, a safety assessment shall be successfully performed and contextual report shall be made available **(MM4 – Safety Assessment)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.

[16] For further information concerning the mean duration of the Family implementation, please refer to the Short-Term Deployment Approach, as reported within Chapter 3.

Family 2.5.1 – Airport Safety Nets associated with A-SMGCS level 2

2.5.1 – Airport Safety Nets associated with A-SMGCS (Level 2)			
Main Sub-AF	S-AF 2.5 Airport Safety Nets		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2021

Description and Scope

Airport safety nets consist of the detection and alerting of conflicting ATC clearances to aircraft and deviation of vehicles and aircraft from their instructions, procedures or routing which may potentially put the vehicles and aircraft at risk of a collision.

The scope of this sub-functionality includes the Runway and Airfield Surface Movement area. ATC support tools at the aerodrome shall provide the detection of Conflicting ATC Clearances as well as deviations from ATC instructions, procedures or routes. This shall be performed by the ATC system based on the knowledge of data including the clearances given to aircraft and vehicles by the air traffic controller, the assigned runway and holding point. The air traffic controller shall input all clearances given to aircraft and/or vehicles into the ATC system using a digital system, such as the digital systems such as Electronic Flight Strips (EFS) or strip less systems (Family 2.1.2). Different types of conflicting clearances shall be identified (for example Line-Up vs. Take-Off). Some may only be based on the air traffic controller input; others may in addition use other data such as A-SMGCS surveillance data.

Airport Safety Nets tool shall alert when aircraft and vehicles deviate from ATC instructions, procedures or routes. The detection of Conflicting ATC Clearances shall aim to provide an early prediction of situations that if not corrected would end up in hazardous situations that could be detected by the runway incursion monitoring system (RIMS) if in operation. Airport Safety Nets tool could be linked to equipment for vehicle drivers to improve situational awareness, reduce the risks of runway incursion, runway and taxiway confusions and thus contribute to the overall airport safety net for high-density airports.

Interdependencies

Family 2.1.2 Digital systems such as Electronic Flight Strips (EFS) or strip less systems: Considering A-SMGCS Level 1 and 2 as a prerequisite for all higher A-SMGCS functions, it is suggested that implementers take account of the need for implementing digital systems such as Electronic Flight Strips (EFS) or strip less systems and linking its functionalities to the A-SMGCS Level 1 & 2 and higher functions where it is considered as a prerequisite.

Family 2.4.1, since A-SMGCS Planning and Routing Functions can be foreseen as a prerequisite for Families 2.5.1 and 2.5.2: A-SMGCS shall include the advanced routing and planning function referred to in Sub-AF 2.4 to enable conformance monitoring alerts.

S-AF 2.4, since A-SMGCS Level 1 and 2 is a pre-requisite for Family 2.5.1:

- Airport Conformance Monitoring shall integrate A-SMGCS Surveillance data (Family 2.2.1), Surface Movement Routing and Planning (Family 2.4.1) and controller routing clearances.

- A-SMGCS shall include a function to generate and distribute the appropriate alerts. These alerts shall be implemented as an additional layer on top of the existing A-SMGCS level 2 alerts and not as a replacement of them.

Synchronization Needs

Depending on local airport specificities and relationship among local ANSPs, Aircraft Operators and Airport Operators, planning and realisation of the implementation of Family 2.5.1 must be synchronised.

In relationship with the fact that some functionalities of Family 2.4.1 are prerequisites for Family 2.5.1, depending on local airport specificities and relationship among local ANSPs and Airport Operators, both should synchronize themselves when relevant, through the planning and the realisation of the implementation of Family 2.5.1 in relationship with the implementation of Families 2.1.2, 2.2.1 and 2.4.1.

Civil / Military Coordination

Applicable to those airports mentioned in the PCP and open to civil and military operations

Stakeholders considered as gaps	ANSPs, Airport Operators	
Other stakeholders involved in the Family deployment	Military Authorities	
Links to ICAO GANP ASBUs	B0-SURF Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2) B1-RSEQ Improved Airport Operations through Departure, Surface and Arrival Management	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AO-0104-A SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	AOP12
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Some functionalities of this Family depend on the implementation of A-SMGCS Routing and Planning Functions (Family 2.4.1) which has a later FOC date (01/01/2024). Where necessary it is therefore recommended to synchronize with Family 2.4.1 or to integrate those functionalities in the respective 2.4.1 IP. It is recommended liaising between different stakeholders (both within the same stakeholder category and between different categories) to draft and present joint proposals in the framework of upcoming Calls. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View. Due to the FOC of Family 2.5.1 being 01/01/2021 and the rather tight schedule for implementing it on time, SDM recommends prioritizing the implementation of this Family at PCP airports to ensure the PCP implementation is achieved in due time.	
Family Deployment Approach[17]	The implementation of the Family would require the upgrade of the existing ATC systems and their integration in the local environment, in order to support the Airport Safety Nets (Sub-AF 2.5), systems that shall also be integrated with A-SMGCS and digital systems such as Electronic Flight Strips (EFS) or strip less systems **(MM1 – Installation and integration in local environment with A-SMGCS and digital systems such as Electronic Flight Strips (EFS) or strip less systems)**. Before the start of the operational use, the Airport Safety Nets Operational Procedures associated to A-SMGCS Level 2 shall be elaborated and subsequently published **(MM2 – Operational Procedures)**, all relevant staff shall be duly trained **(MM3 – Training)**, a safety assessment shall be successfully performed and contextual report shall be made available **(MM4 – Safety Assessment)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.	

[17] For further information concerning the mean duration of the Family implementation, please refer to the Short-Term Deployment Approach, as reported within Chapter 3.

Family 2.5.2 – Vehicle systems (part A) and aircraft systems (part B) contributing to Airport Safety Nets

2.5.2 Vehicle systems (part A) and aircraft systems (part B) contributing to Airport Safety Nets			
Main Sub-AF	S-AF 2.5 Airport Safety Nets		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2021

Description and Scope

This Family represents an enabler and a facilitator to the safety-focused PCP deployment. The objective is to equip vehicles (part A) and aircraft (part B) operating in the manoeuvring area of airports with safety related systems to improve situational awareness, reduce the risks of runway incursion/excursion and runway confusion contributing to the overall airport safety net for high-density airports.

Airport Safety Nets consist of the detection and alerting of conflicting ATC clearances to aircraft and deviation of vehicles and aircraft from their instructions, procedures or routing which may potentially put the vehicles and aircraft at risk of incidents/accidents.

The scope of this Family includes:

For part A:

- on-board vehicle displays including on-board vehicle safety nets and alerting functions, with the objective to support the ground-based airport safety net with specific vehicle systems and technology;

For part B:

- aircraft technology in the scope of avionic or Electronic Flight Bag based systems with the objective to conclude the ground-based airport safety net with specific airborne systems and technology;
- under Family 2.5.2, it is not foreseen to provide the complete "aircraft picture" to the "Air Traffic Controller", nor to provide the complete "Air Traffic Controller picture" to the cockpit.

This leads to an improved situational awareness and thus improves the quality of the overall airport safety net. The main benefit is related to the increase of runway usage awareness, and consequently an increase of overall safety including the whole airport manoeuvring area.

On-board vehicle systems and technology (Part A) and on-board aircraft systems and technology (Part B) use airport data coupled with on-board vehicle and aircraft sensors to monitor the movement of aircraft and vehicles on the airport surface and provide relevant information to drivers, flight crew and ATC.

The on-board aircraft and vehicle systems detect potential and actual risk of incidents/accidents with other traffic on the manoeuvring area and provide the drivers and the flight crew with the appropriate alert.

An aircraft on-board Airport Safety Nets will improve safety in runway operations, mostly at airports where no safety net is provided to controllers. It should be noted that not all vehicles may need to be equipped with relevant systems and technology. For instance, during snow removal, it would probably be enough to only equip the lead and end vehicles.

Interdependencies

Part A:

Family 2.1.2 Digital systems such as Electronic Flight Strips (EFS) or strip less systems: Considering A-SMGCS Level 1 and 2 as a prerequisite for all higher A-SMGCS functions, it is suggested that implementers take account of the need for implementing digital systems such as Electronic Flight Strips (EFS) or strip less systems and linking its functionalities to the A-SMGCS Level 1 & 2 and higher functions where it is considered as a prerequisite. S-AF 2.4 since A-SMGCS Level 1 is a prerequisite for Family 2.4.1

- Airport Conformance Monitoring shall integrate A-SMGCS Surveillance data (Family 2.2.1), Surface Movement Routing and Planning (Family 2.4.1) and controller routing clearances.

- When relevant, A-SMGCS shall include the advanced routing and planning function referred to in Sub-AF 2.4 to enable conformance monitoring alerts.

- A-SMGCS shall provide -optimized taxi-time and improve predictability of take-off times by monitoring of real surface traffic and by considering updated taxi times in departure management regardless of meteorological or other impacting conditions.

S-AF 2.2, since A-SMGCS Level 1 and 2 is a prerequisite for Family 2.5.2 (Part A):

- Airport Conformance Monitoring shall integrate A-SMGCS Surveillance data (Family 2.2.1), Surface Movement Routing and Planning (Family 2.4.1) and controller routing clearances.

- A-SMGCS shall include a function to generate and distribute the appropriate alerts. These alerts shall be implemented as an additional layer on top of the existing A-SMGCS level 2 alerts and not as a replacement of them.

Part B:

N/A

Synchronization Needs

Part A:

Depending on local airport specificities and relationship among local ANSPs and Airport Operators, planning and realisation of implementation of Sub-AF 2.5 must be synchronised. More specifically, ATCOs must be informed about the implementation of vehicle on-board systems and the potential consequences for ATC.

In relationship with the fact that some functionalities of Family 2.4.1 are prerequisites for Sub-AF 2.5 Families, depending on local airport specificities and relationship among local ANSPs and Airport Operators, planning and realisation of implementation of Family 2.5.2 (Part A) must be synchronised, when relevant, in relationship with the implementation of Families 212, 221, 2.4.1 and 2.5.1.

Part B:

Depending on local airport specificities and relationship among local ANSPs, Aircraft Operators and Airport Operators, planning and realisation of implementation of Family 2.5.2-b must be synchronised. More specifically, ATCOs must be informed about the implementation of aircraft on-board systems and the potential consequences for ATC.

Civil / Military Coordination

Applicable to those airports mentioned in the PCP and open to civil and military operations

Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users	
Other stakeholders involved in the Family deployment	Military Authorities	
Links to ICAO GANP ASBUs	B1-SURF Enhanced Safety and Efficiency of Surface Operations – SURF, SURF-IA and Enhanced Vision Systems (EVS) B2-SURF Optimized Surface Routing and Safety Benefits (A-SMGCS Level 3-4 and SVS)	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AUO-0401 Available AO-0105 SESAR Release 5 AO-0204 SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	AOP15

Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.
Recommendations for IPs proposal	Some functionalities of this Family depend on the implementation of A-SMGCS Routing and Planning Functions (Family 2.4.1) which has a later FOC date (01/01/2024). Where necessary, it is therefore recommended to synchronize with Family 2.4.1 or to integrate those functionalities in the respective 2.4.1 IP. It is recommended liaising between different stakeholders (both within the same stakeholder category and between different categories) to draft and present joint proposals in the framework of upcoming Calls. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View. Due to the FOC of Family 2.5.2 being 01/01/2021 and the rather tight schedule for implementing it on time, SDM recommends prioritizing the implementation of this Family at PCP airports to ensure the PCP implementation is achieved in due time.
Family Deployment Approach[18]	The implementation of the Family would require to relevant equipment for vehicles and aircraft to be delivered and implemented in order to be integrated in the local environment. ATC systems shall be concurrently upgraded and installed in order to support Airport Safety Nets (Sub-AF 2.5) **(MM1 – Installation and integration)**. Before the start of the operational use, Operational Procedures related to such systems shall be elaborated and subsequently published **(MM2 – Operational Procedures)**, all relevant staff shall be duly trained **(MM3 – Training)**, a safety assessment shall be successfully performed and contextual report shall be made available **(MM4 – Safety Assessment)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.

[18] For further information concerning the mean duration of the Family implementation, please refer to the Short-Term Deployment Approach, as reported within Chapter 3.

4.3 AF #3 – Flexible ASM and Free Route

Family 3.1.1 – ASM tool to support AFUA

3.1.1 – ASM Tool to support AFUA			
Main Sub-AF	S-AF 3.1 Airspace Management and Advanced Flexible Use of Airspace		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2022

Description and Scope

Deployment of local automated ASM (Airspace Management) systems or utilization of services supporting ASM tools and functions (e.g. CIAM), and their interoperability with NM systems and neighbouring ASM systems/services to manage ARES (Airspace Reservations) shall improve civil-military co-ordination and lead to greater flexibility according to airspace users' needs.

Automated ASM support system/service shall:

- improve airspace management processes and flexible airspace planning including time horizon specifications in all flight phases (strategic, pre-tactical and tactical time horizon) by providing mutual visibility on civil and military requirements;
- support a flexible airspace planning according to civil and military ANSPs and airspace user requirements, extended also to permit cross border and use of segregated areas operations regardless of national boundaries;
- support dynamic airspace management and flexible sector configurations;
- address the strategic/long term, pre-tactical planning and tactical operations;
- be compatible and ensure uninterrupted data flow with NM system and neighbouring ASM systems/services between the pre-tactical planning and real-time airspace status;
- include the possibility to provide data for impact assessment and share results of impact evaluation of different airspace configurations on the network;
- be interoperable with NM systems and neighbouring ASM systems/services.

Interdependencies

Family 3.1.1 is a prerequisite for Family 3.1.2, that needs ASM systems/services which shall support the real-time data exchange of airspace status.

Family 3.1.1 is a prerequisite for Family 3.1.3, that needs ASM systems/services to support ASM/ATFCM data exchange.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services specifically through Family 5.3.1 and 5.5.1 services as listed in the Appendix 1 of this Chapter.

Synchronization Needs

Synchronization among Military and Civil AUs, Military and Civil ANSPs.

Synchronization with NM for the real time sharing/distribution of data about ARES, airspace structure and utilization within ASM systems/services. Since this Family is a prerequisite, its implementation completion is needed before the implementation of the families 3.1.2 and 3.1.3. Operational and technical synchronisation between NM, National Airspace Management Cells, Civil-Military AUs and Civil-Military ANSPs is required to achieve the full interoperability between the systems.

Civil / Military Coordination

A civil-military coordination is beneficial for procedural and operational purposes as well as for systems in order to process ARES Status data.

Enablers for civ-mil coordination are support systems/services and procedures to share ASM information and manage ASM level 2.

This initiative is to deploy local ASM support systems or the utilization of services supporting ASM functions, meeting a baseline definition to manage airspace locally based on civil – military coordination (Pre-Tactical Level 2 or Tactical Level 3). Military Air Planning entities should have an interface with ASM support system/service.

Stakeholders considered as gaps	Civil-Military ANSPs, Network Manager and Military AUs	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B0-FRTO Improved Operations through Enhanced En-route Trajectories	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AOM-0202 Available
	ATM Master Plan Level 3 (Edition 2019)	AOM19.1
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	ASM tool implementation allows data exchange with NM and neighbouring ANSPs in support of ARES coordination and it covers the prerequisite for 3.1.2 and 3.1.3. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	The implementation of the Family requires the successful installation of the local ASM Tool or the utilization of services supporting ASM tools, as an enabler for the support of civil - military coordination **(MM1 – ASM tool installation)**. Monitoring and operational validation activities shall be completed in order to ensure interoperability (via B2B) **(MM2 – ASM tool integration)**. Procedures for operational and technical use of the system/service shall be provided **(MM3 – Procedures available)**, all safety assessments required duly executed **(MM4 – Safety assessment)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.	

Family 3.1.2 – ASM Management of real time airspace data

3.1.2 – ASM Management of real time airspace data			
Main Sub-AF	S-AF 3.1 Airspace Management and Advanced Flexible Use of Airspace		
Readiness for implementation	High		
Initial Operational Capability	01/01/2017	**Full Operational Capability**	01/01/2022

Description and Scope

Airspace management (ASM) is enhanced by the automated exchange services of ASM data during the tactical and execution phases, continuously in real time.

ASM information (real-time ARES status) are shared between ASM systems, civil and military ATS units/systems and communicated to the NM in the tactical and execution phases up to Tactical level 3.

This data consists of pre-notification of activation, notification of activation, de-activation, modification and release. They are collected, saved, processed and exchanged between ASM stakeholders and made available by the NM system to ATM actors and all airspace users not involved in ASM process but concerned by this data.

The scope of this Family encompasses:

- Procedural and system upgrades (ASM, ATM, NM and Civil-Military AU systems-i.e. CFSP) for exchange of real time airspace status data where required;
- integration and management of ASM real-time data into ANSPs ATM systems and into AUs (CFSP, etc.) flight planning systems where required;
- full sharing of real time airspace status updates in planning and/or execution phases, in order to take early advantage of possible opportunities and/or to achieve real time awareness of airspace features.

Interdependencies

Prerequisite for this Family is the implementation of an ASM tool, as foreseen in Family 3.1.1 - ASM tool to support AFUA that supports real-time exchange as for Tactical Level 3. The ASM tool is essential for the implementation of this Family, that cannot be done if Family 3.1.1 is not completed.

Family 3.1.3 - Full rolling ASM/ATFCM process and ASM information sharing is beneficial to enhance distribution and management of real-time data exchange in addition to the benefits brought by this Family.

Family 4.4.2 Interactive Rolling NOP will enhance the real-time airspace data exchange.

Family 4.2.3 information exchange between ATM systems to NM systems will enhance all families in Sub-AF 3.1.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Family 5.3.1, 5.5.1 and 5.6.1 or 5.6.2 services as listed in the Appendix 1 of this Chapter.

Synchronization Needs

Synchronization among Military and Civil AUs, Military and Civil ANSPs.

Synchronization with NM for the real time sharing/distribution of data about ARES, airspace structure and utilization within ASM systems/services. The implementation of this Family is achievable only after the completion of the Family 3.1.1.

Operational and technical synchronization between NM, Airspace Management Cells, Civil and Military AUs, Civil and Military ANSPs is needed for the harmonization of real-time exchange and management of required data.

<table>
<tr><th colspan="3">Civil / Military Coordination</th></tr>
<tr><td colspan="3">A civil-military coordination is beneficial for procedural and operational purposes as well as for systems in order to process ARES Status data.
Enablers for civ-mil coordination are support systems and procedures to share real time ASM information and manage ASM level 3.
This initiative is to upgrade the local ASM support systems or implement other means to meet the requirements of civil military coordination at level 3.</td></tr>
<tr><td>Stakeholders considered as gaps</td><td colspan="2">Civil-Military ANSPs, Network Manager, Military AUs</td></tr>
<tr><td>Other stakeholders involved in the Family deployment</td><td colspan="2">Airspace Users (CFSPs)</td></tr>
<tr><td>Links to ICAO GANP ASBUs</td><td colspan="2">B0-FRTO
Improved Operations through Enhanced En-route Trajectories
B0-NOPS
Improved flow performance through planning based on a network-wide view
B1-NOPS
Enhanced flow performance through network operational planning</td></tr>
<tr><td rowspan="2">ATM Master Plan References</td><td>ATM Master Plan Level 2 (Dataset 19)</td><td>AOM-0206-A
SESAR Release 5
AOM-0202-A
SESAR Release 5</td></tr>
<tr><td>ATM Master Plan Level 3 (Edition 2019)</td><td>AOM19.2</td></tr>
<tr><td>Cyber security Requirements</td><td colspan="2">SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.</td></tr>
<tr><td>Recommendations for IPs proposal</td><td colspan="2">The scope of this Family might require changes in ATM systems, AU systems and NM systems, which need to be undertaken after the deployment of ASM tools in support of real time airspace status updates, in planning and execution phase.
It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.</td></tr>
<tr><td>Family Deployment Approach</td><td colspan="2">The implementation of the Family requires the successful upgrade of the ASM tool (MM1 – Upgrade of ASM tool), to support a continuous real-time data exchange during the tactical phase in order to manage airspace data and airspace status (MM2 – System updates for the exchange of real time airspace data).
All the relevant data shall be integrated into ATM Systems. Interoperability with the Network Manager system and with other ASM systems shall be carefully monitored and verified (MM3 – Systems integration with ATM, ASM and NM systems).
Procedures for operational and technical use of the system shall be provided (MM4 – Procedures available), all safety assessments required duly executed (MM5 – Safety assessment).
The execution of such activities is expected to lead to the start of permanent operational use (MM6 – Implementation completed).</td></tr>
</table>

Family 3.1.3 – Full rolling ASM/ATFCM process and ASM information sharing

3.1.3 – Full rolling ASM/ATFCM process and ASM information sharing			
Main Sub-AF	S-AF 3.1 Airspace Management and Advanced Flexible Use of Airspace		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2022

Description and Scope

This process focuses on airspace planning improvements and to ensure a continuous, seamless and reiterative planning, allocation and operational deployment of optimum airspace configurations, based on airspace request at any time period. It will result in a rolling process, supporting the enhancement of the daily Network Operations Plan. This will allow airspace users to take greater benefit from changes in airspace structures in the execution phase.

This will be supported by the sharing of military and civil airspace data and by continuously updating Airspace Reservation information and other civil demand information among the authorized users and approved agencies. The aim is to enhance the coordination of Cross Border Operations (including Cross Border Area) with attention to military restrictions on sharing airspace data with outside alliances. This shall optimize network operations based on the richest and most up-to-date information.

ASM information sharing addresses the required system support improvements or the implementation for the use of ASM support services (e.g. CIAM) to enable a seamless data flow and their management in the framework of the enhanced CDM process. It includes requirements aiming to improve notifications to airspace users based on automation of data exchange. The scope of this Family encompasses:

- Process/system upgrade or utilization of service providing ASM functions supporting a full rolling ASM/ATFCM and dynamic ASM/ATFCM process allowing data sharing to all operational stakeholders, although some States with limited airspace booking needs may fully rely on NM system capabilities;
- ASM systems/services and AU systems upgrades to continuously exchange ASM information;
- technical changes supporting rolling AUP and rolling UUP (Pre-Tactical Level 2 or Tactical Level 3);
- initial implementation of FUA/EU restriction and FBZ in NM system and local/regional ASM systems;
- full implementation of new AUP template content and format (AIXM coding definition) perspective;
- process/System improvements supporting sharing of information of airspace configurations (via AUP/UUP), full management of Airspace structure (taking into account AUP/UUP information), initial CDM and CDM in FRA network impact assessment;
- harmonize cross border CDRs and ARES notifications;
- implement Graphical display of AUP/UUP on NOP Portal (with lateral/vertical limits indication);
- ASM management and data sharing shall be addressed where airspace is managed dynamically with no fixed-route network.

Interdependencies

The ASM tools to support AFUA (Family 3.1.1) are essential for the implementation of this Family that cannot be done if Family 3.1.1 is not completed.

Family 3.1.2 – ASM management of real-time data focuses mainly on the real-time data sharing. The benefits of this Family are complementary and enhanced by the implementation of Family 3.1.3.

Family 3.1.4 - Management of dynamic airspace configurations whose implementation, to some extent is supported by the implementation of Family 3.1.3. As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Families 5.3.1, 5.5.1 and 5.6.1 or 5.6.2 services as listed in the Appendix 1 of this Chapter.

Synchronization Needs
Synchronization among Military and Civil AUs, Military and Civil ANSPs. Synchronization with NM for the real time sharing/distribution of data about ARES, airspace structure and utilization within ASM systems/services. The implementation of this Family is achievable only after the completion of the Family 3.1.1 with the implementation of any ASM tool. Operational and technical synchronization between NM, Airspace Management Cells, Civil and Military AUs, Civil and Military ANSPs is needed for the harmonization of exchange and management of required data.
Civil / Military Coordination
A civil-military coordination is beneficial for procedural and operational purposes as well as for systems in order to process ARES Status data.

Stakeholders considered as gaps	Civil-Military ANSPs, Civil-Military AUs (CFSPs), Network Manager	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B0-FRTO Improved Operations through Enhanced En-route Trajectories B0-NOPS Improved flow performance through planning based on a network-wide view B1-NOPS Enhanced flow performance through network operational planning	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AOM-0202-A SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	AOM19.3
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	This Family is a key feature for the European airspace planning process and the continuous update of information about: ARES via AUP/UUP, traffic demand and necessary data among all stakeholders in a full rolling process. Due to its FOC being 01/01/2022 and the rather tight schedule for implementing it on time, SDM recommends all involved stakeholders to prioritize the implementation of this Family submitting proposals for process/systems updates. This is in order to achieve full management of shared information and to ensure the PCP implementation is achieved in due time. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	

Family Deployment Approach [19]	The implementation of the Family would require the identification of systems upgrade in order to include the technical changes required **(MM1 – System updates for the full rolling ASM/ATFCM process and ASM information sharing)**. All Civil, Military, AU and NM Systems, shall be integrated for information and data sharing, which shall then be properly monitored and verified **(MM2 – Integration completed)**. Procedures for operational and technical use shall be provided **(MM3 – Procedures available)**, all safety assessments required duly executed **(MM4 – Safety assessment)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.

[19] For further information concerning the mean duration of the Family implementation, please refer to the Short-Term Deployment Approach, as reported within Chapter 3.

Family 3.1.4 – Management of dynamic airspace configurations

3.1.4 – Management of Dynamic Airspace Configurations			
Main Sub-AF	S-AF 3.1 Airspace Management and Advanced Flexible Use of Airspace		
Readiness for implementation	Medium		
Initial Operational Capability	01/01/2018	**Full Operational Capability**	01/01/2022

Description and Scope

The ASM solutions process is aimed at delivering ASM options that can help alleviate capacity problems identified in any particular area of European airspace as well as improve flight efficiency assessing impact on capacity and ensuring synchronized availability of optimized airspace structures based on traffic demand and dynamic sectors management.

The Airspace configurations are pre-defined and coordinated airspace structures (based on CDRs, DCTs, FRA, including ARES, VPA/DMA and so on) and ATC dynamic sectorisation, to meet airspace needs in terms of capacity and/or flight efficiency. Airspace configurations and ATC flexible sectors configuration are already used when the flows and constraints can be predicted well in advance (e.g. weekend routes or seasonal flows of traffic). A more efficient and dynamic process involving the NM, ATFCM, ATC and military would require new functionalities and procedures and well defined collaborative decision-making processes at pre-tactical and tactical level. Dynamic Airspace Configuration focuses on defining a reference to Dynamic Airspace Configuration concept, including roles and responsibilities in an advanced CDM process. The ASM performance analysis should assess the flight efficiency gains resulting from the rolling ASM/ATFCM process implementation. The Capacity aspects need also to be addressed.

The scope of this Family encompasses:

- Improved ASM solution process;
- process/System changes for predefined airspace configurations including DCTs and FRA;
- ASM/ATFCM systems and ATM systems should support the full sharing of the dynamic airspace configuration inputs and outputs via specific B2B services. The notification of Airspace Configurations will be based on automatic flows of information between the different stakeholders provided by Network Manager;
- system improvements supporting the management of dynamic airspace configuration including DCTs and FRA (included implementation of ATM VoIP communications enabling dynamic airspace configuration);
- implement supporting tools for ASM performance analysis.

Interdependencies

Family 3.1.3 – Full rolling ASM/ATFCM process and ASM information sharing that partially supports the implementation of Family 3.1.4 enhancing the management of ARES of CBA.

Family 3.1.2 ASM Management of real time airspace data that partially supports the implementation of Family 3.1.4 enhancing the management of ARES data.

Family 4.2.3 information exchange between ATM systems to NM systems will enhance all families in S-AF 3.1

Family 4.4.2 Traffic complexity tools will enhance the dynamic airspace configurations by assessing the impact of traffic demand on complexity of volumes of airspace.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Families 5.3.1, 5.5.1 and 5.6.1 or 5.6.2 services as listed in the Appendix 1 of this Chapter.

Synchronization Needs		
Synchronization among Military and Civil AUs, Military and Civil ANSPs. NM is beneficial for the real time sharing/distribution of dynamic airspace configuration elements (ARES, sectorisation plans, etc.) needed to allow a correct evaluation for the optimization of airspace configurations. NM provides the predefined airspace configuration and will continue with the provision of optimised/dynamic airspace configuration proposals. The implementation of this Family is partially supported by the implementation of other families in Sub-AF 3.1. Operational and technical synchronization between NM, Airspace Management Cells, Civil and Military AUs, Civil and Military ANSPs with regards to the implementation of Families 5.3.1, 5.5.1 and 5.6.1 is needed for a most optimized airspace management.		
Civil / Military Coordination		
A civil-military coordination is beneficial for procedural and operational purposes as well as for systems in order to process ARES Status data.		
Stakeholders considered as gaps	Civil-Military ANSPs, Network Manager	
Other stakeholders involved in the Family deployment	Military Authorities	
Links to ICAO GANP ASBUs	B0-FRTO Improved Operations through Enhanced En-route Trajectories B0-NOPS Improved flow performance through planning based on a network-wide view B1-NOPS Enhanced flow performance through network operational planning	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	CM-0102-A SESAR Release 2
	ATM Master Plan Level 3 (Edition 2019)	COM11.1, AOM19.4
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	The deployment of predefined airspace configuration could start from the beginning of 2018 onwards. IP proposals should be focused on concept and study of ASM solutions achieving a more efficient process (included new system functionalities, if envisaged) supporting optimized airspace structure and availability, ATC dynamic sectors management, to enhance flight efficiency and alleviate capacity problems with reference to predefined airspace configurations. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	The implementation of the Family would require the definition of a pre-defined airspace configuration concept, including implementation of ATM VoIP communications which supports dynamic sectorisation. This shall provide deliverables such as CONOPS, whilst also sharing roles and responsibilities in an advanced CDM perspective **(MM1 – Pre-defined airspace configuration concept definition)**.	

	ATM systems shall be subsequently upgraded as required **(MM2 – ATM systems upgrade)**. The installation of new software and/or tools shall be successfully completed **(MM3 – SW/Tools installation)** and the ANSP-NM integration of such SWs/Tools among all Stakeholders systems shall be closely monitored and verified **(MM4 – SW/Tools integration)**. Procedures for its operational and technical use shall be provided **(MM5 – Procedures available)**, all safety assessments required duly executed. **(MM6 – Safety assessment)**. All relevant personnel involved shall be appropriately trained **(MM7 – Training of personnel)** The execution of such activities is expected to lead to the start of permanent operational use **(MM8 – Implementation completed)**.

Family 3.2.1 – Upgrade of ATM systems (NM, ANSPs, AUs) to support Direct Routings (DCTs) and Free Routing Airspace (FRA)

3.2.1 – Upgrade of ATM systems (NM, ANSPs, AUs) to support Direct Routings (DCTs) and Free Route Airspace (FRA)			
Main Sub-AF	S-AF 3.2 Free Route		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2022

Description and Scope

NM systems have been upgraded to support Free Route operations that can be done by means of published DCTs (initial step before 01/2018) or directly FRA. Only some corrections and tuning are required for DCTs. The NM system upgrades related to dynamic re-routing, ATFCM planning and execution and traffic load management are part of AF 4 families, namely 4.1.2 and 4.4.2. The AU flight plan filing systems (CFSP) should be upgraded (e.g. to support long DCT segments and handling of LAT/LONG, if required). Specific attention should be given to the management of any ASM/ATFCM constraint in a FRA environment, and to the necessary standardisation of free route implementation concerning the flight planning requirements.

The ANSP system upgrades include the FDPS (e.g. management of FPL trajectories including LAT/LONG and/or enhanced management of trajectories by eFPL), the Controller Working Position (CWP) and the HMI which need to support DCTs/FRA. ATC systems may also be upgraded, for example, with CPDLC messages handling LAT/LONG, CPDLC reception and use data from aircraft coming from ADS-C EPP when these data link services are implemented.

Although the above-mentioned requirements do not make a direct reference to Multi-Sector Planner/Extended ATC Planner (MSP/EAP) function, the indirect links do exist and MSP/EAP deployment in the context of DCTs/FRA should be considered. The system upgrades can be clustered in 3 points:

1. For State/Regional (e.g. cross-border) DCTs they shall encompass:
   - NM systems:
     - FPL processing and checking
     - Dynamic rerouting
     - Calculation and management of traffic load
   - AU systems:
     - FPL route planning for a complete flight taking into account the differences of implementation and limitations (e.g. in terms of opening time and/or flight level constraints) throughout the entire flight.
     - Long DCT with or without calculated intermediate points.
   - ATC systems:
     - FDPS supporting airspace structure managing trajectories according to flight planning
     - CWP and HMI supporting appropriate display and functions as required by operational needs
2. For State/Regional (e.g. cross-border) FRA deployment they shall encompass the upgrades listed in point 1) plus:
   - NM systems:
     - IFPS routing proposal
     - Specific ASM improvements for FRA
     - Network impact assessment for FRA
     - CACD adaptations for FRA national deployment
   - AU systems:
     - Capability to take into account the different constraints, e.g.: ATS, DCT/FRA, RAD, scenarios, FL constraints on part of the route only, etc
     - FPL route planning for a complete flight taking into account the differences of implementation (DCT, FRA with or without partial implementation) throughout the entire flight.

- ATC systems:
  - FDP to calculate ground 4D trajectories within AoI and editing function for 4D trajectories including Cross AoR Points (COP management)
  - ASM/ATFCM for FRA management
  - MTCD (detecting conflicts between A/C and A/C)
  - CORA (conflict probe and passive conflict resolution advisor)
  - MONA (conformance monitoring aids)
  - ATC clearances beyond AoR
  - ATC to ATC Flight Data Exchange (Basic OLDI and SYSCO)
  - Dynamic sectorization and constraint management
  - Dynamic Area Proximity Warning (APW) –Integrated with ASM tools
  - Provision/integration of FP and real-time data related to the FRA traffic to the Military ATS units
  - Conflict Detection Tools which include the Tactical Controller Tool (TCT), using the tactical trajectory and managing the clearances along that trajectory

3. For Pan-European FRA deployment they shall encompass the upgrades listed in point 2) plus:

- NM systems:
  - CACD environmental database adaptations for FRA cross-border operations
  - B2B data exchange for cross border FRA
- ATC systems:
  - COP management for FRA supporting Cross Border COP handling
  - Tactical Controller Tool (TCT), managing the Cross-Border clearances
- AU systems:
  - Optimisation of free routing trajectory taking into account the ATM constraints including possible differences of FRA lower limit implementations throughout the flight

Interdependencies

3.1.3 Full rolling ASM/ATFCM process and ASM information sharing supports – as stated in the PCP IR – the introduction of DCT and FRA.

Family 4.2.3 Information exchange between ATM systems to NM systems will support interoperability and enhance data sharing.

Family 4.4.2 Traffic Complexity tools may provide additional value to the upgrades required within Family 3.2.1.

Family 1.1.2 AMAN upgrade to include Extended Horizon function may enhance the systems upgrades supporting FRA.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Families 5.3.1, 5.4.1, 5.5.1, and 5.6.1 or Family 5.6.2 services as listed in the Appendix 1 of this Family Descriptions Chapter.

Family 6.1.3 A/G and G/G Multi Frequency DL Network in defined European Service Areas may improve the performances of FRA implementation.

Synchronization Needs

Coordination and sharing of system requirements among ANSPs, NM and AUs (CFSPs) are supporting the interoperability needs, adequate sharing and efficient management of data in the perspective of FRA implementation (especially when FRA is deployed cross-border).

Synchronization and coordination among ANSPs, NM and AUs (CFSPs) in the perspective of FRA implementation, are highly recommended with regards to the families that support data exchange (AF4-AF5). Synchronization with most families that imply system upgrades, even not mandatorily required for FRA, will add benefits addressing FRA implementation.

Civil / Military Coordination

Civil-military Coordination is beneficial for, i.e. Basic Flight Data (BFD) and Change Flight Data (CFD), other. Military ATC Systems shall be capable to process all DCT Information.

Stakeholders considered as gaps	Civil-military ANSPs, Civil-Military AUs (CFSPs), Network Manager	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B0-FRTO Improved Operations through Enhanced En-route Trajectories B1-FRTO Improved Operations through Optimized ATS Routing	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	CM-0202 Available CM-0203 Available AOM-0500 SESAR Release 5 AOM-0501 SESAR Release 5 AOM-0505 SESAR Release 9 CM-0102-A SESAR Release 2
	ATM Master Plan Level 3 (Edition 2019)	AOM21.1, AOM21.2, ATC02.8, ATC12.1, ATC17, COM11.1
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	It is recommendable that ANSPs, NM and AUs submit IPs for procurement / upgrade of their systems for FRA operations. The stakeholders that deployed the system upgrades related to FRA should be encouraged to consider further upgrades related to cross-border, National/Regional and Pan-European deployment, in the perspective that large scale deployments (e.g.: at FAB level, 24h, with minimum entry/exit conditions/constraints) are recommendable as producing most benefits, and that these would be maximized with future Pan-European deployment. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	These Milestones shall be applicable for any system upgrade or implementation of a specific function/tool required for full FRA implementation. The implementation of the Family would require the definition of CONOPS for the system/functions **(MM1 – Concept of the new system/functions definition)**, the preparation of the related technical and operational specifications **(MM2 – Operational and technical requirements preparation)** and the signature of the contract(s) for the supplying, installation and integration of such system/functions (**MM3 – Procurement of new system/functions**). In order for the system/functions to be set for operational use, the Factory as well as the Site acceptance test and validation shall be successfully performed **(MM4 – Factory Acceptance Test for new system/functions, MM5 – Site Acceptance Test for new system/functions)**, both illustrated in the Family description.	

	Such updated systems shall then be installed **(MM6 – Systems installation)** and their integration, in particular ANSP-ANSP for OLDI and SYSCO, NM-ANSP for FRA airspace definition and NM-CFSP for flight planning requirements, shall be carefully monitored and verified **(MM7 – Systems integration)**. Further activities shall be performed to make such systems available and, more in detail, tailored procedures shall be established and provided for the operational/technical use of the new SWs/tools **(MM8 – Procedures available)**, all safety assessments required shall be duly executed and all the output documents shall then be timely released **(MM9 – Safety assessment)**, all relevant personnel involved shall be appropriately trained **(MM10 – Training of personnel)**, the transition plan prepared and the related transition phase initiated **(MM11 – Transition from legacy system to new one)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM12 – Implementation completed)**.

Family 3.2.3 – Implement Published Direct Routings (DCTs)

3.2.3 – Implement Published Direct Routings (DCTs)			
Main Sub-AF	S-AF 3.2 Free Route		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2018

Description and Scope

DCTs have reached the deadline of FOC (01 January 2018). The publication of flight plannable DCTs represents an initial step toward Free Route Airspace implementation where full deployment of FRA, especially in high complexity environment, may not be the best solution in terms of performances.

DCTs may be implemented within a State or between States on a cross border basis. Within this airspace, flights remain subject to air traffic control.

DCTs shall be published in aeronautical publications as described in the European Route Network Improvement Plan (ERNIP) of the Network Manager.

To facilitate early implementation before the target deployment date, DCTs may be implemented in a limited way e.g.:

- Time constraint (fixed or depending on traffic/availability)
- Traffic Constraint (based on flow and/or level of traffic)
- Flight level
- Lateral Constraints
- Entry/exit conditions

Interdependencies

The implementation of DCTs is often dependent on airspace design and in particular airspace reservations involving civil/military coordination, including OAT (OATTS-like) routes therefore there is a strong link with all families in S-AF-3.1 ASM and Advanced FUA. Family 3.2.1 - Upgrade of ATM systems (NM, ANSPs, AUs) to support DCTs and FRA may facilitate the implementation of Family 3.2.3.

Synchronization Needs

Synchronization and coordination among ANSPs, NM and AUs (CFSPs) in all phases of system upgrades, are required for the full interoperability, adequate sharing and efficient management of data. They are also essential in cross-border DCT implementation.

There is the need to coordinate/synchronize efforts (operational procedures) between ANSPs, NM and Airspace users to ensure adequate performances for the return of investment and/or the start of operational benefits. Coordinated activities for cross-border DCT implementation at FAB and inter-FAB level are required.

The implementation of DCTs is harmonized through the NM European Route Network Improvement Plan (ERNIP) and the Network Operations Plan following the Strategic Objectives and Targets set in the Network Strategic Plan and in the Network Manager Performance Plan.

Civil / Military Coordination

Civil-Military Coordination is beneficial for correct publication of the routes, to have ARES data available as soon as possible for planning and navigation purposes, for interfaces upgrade and full interoperability.

Stakeholders considered as gaps	Civil-Military ANSPs, Network Manager
Other stakeholders involved in the Family deployment	Civil-Military AUs

Links to ICAO GANP ASBUs	B0-FRTO Improved Operations through Enhanced En-route Trajectories B1-FRTO Improved Operations through Optimized ATS Routing	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AOM-0500 SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	AOM21.1
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	DCTs deadline was 1 January 2018, and the Family is considered as fully implemented within the PCP geographical scope. It was considered being an intermediate step (not mandatory) towards FRA implementation.	
Family Deployment Approach	The implementation of the Family would require the identification of DCTs and the airspace where they will be implemented. Coordination with the Military Authority and NM shall be performed and with FAB partners/neighbouring states when necessary **(MM1 – DCT airspace definition)**; fast and real-time simulations should be executed, if required, to assess and validate the impact of DCTs. Where its involvement is envisaged, NM could cooperate and validate these simulations **(MM2 – Fast and Realtime Simulation)**. Operational procedures shall be provided **(MM3 – Procedures available)** and Direct Routings shall be published into the relevant aeronautical documents **(MM4 – Publication of Direct Routings)**, all safety assessments required duly executed **(MM5 – Safety assessment),** appropriate training of ATCOs, where required, should be performed **(MM6 Training of personnel)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM7 – Implementation completed)**.	

Family 3.2.4 – Implement Free Route Airspace

3.2.4 – Implement Free Route Airspace			
Main Sub-AF	S-AF 3.2 Free Route		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2022

Description and Scope

Free Route is an operational concept that enables airspace users to fly as close as possible to what they consider the optimal trajectory without the constraints of fixed route network structure.

Free Route Airspace (FRA) is a specified airspace within which users may freely plan a route between defined FRA entry points and defined FRA exit points, with the possibility to route via intermediate (published or unpublished) waypoints, without reference to the ATS route network, subject to airspace availability. Within this airspace, flights remain subject to air traffic control. Reg. 716/2014 requires FRA deployment, at national level above FL305 by end of 2021.

To facilitate early implementations before the target deployment date, FRA may be implemented through intermediate steps (Family 3.2.3 - DCTs implementation is considered one of them) that allow best practice before full readiness for FRA implementation as specified in the PCP. This may be achieved with some limitations, for example:

- laterally and vertically;
- during specific periods;
- with a set of entry/exit conditions
- with initial system upgrades, etc.

FRA shall be published in aeronautical publications as described in the European Route Network Improvement Plan of the Network Manager. FRA shall be deployed at national level and may progress to FAB Regional level and express most benefits at Pan-European level deployment. The implementation of FRA operations should be based on performance indicators.

Interdependencies

Sub-AF 1.2 Enhanced Terminal Airspace using RNP Based Operations may improve the performance / benefits of FRA implementation.

Sub-AF-3.1: ASM and Advanced FUA because the implementation of FRA is dependent on airspace structure and in particular on airspace reservations involving civil/military coordination including OAT (OATTS-like) routes, optimization and adequate use of the airspace availability.

Family 3.2.1 - Upgrade of ATM systems (NM, ANSPs, AUs) to support DCTs and FRA is required to adequately manage FRA implementation.

Family 3.2.3 – Implement Published Direct Routings (DCTs) was an optional intermediate step that could be implemented before FRA deployment.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Families 5.6.1 and 5.6.2 services as listed in the Appendix 1 of this Chapter that will enhance FRA management.

Synchronization Needs

Synchronization and coordination among ANSPs, NM and AUs (CFSPs) in all phases of implementation are required. Synchronization and coordination are essential in cross-border FRA implementations. The airspace structure, its utilization and management by all the stakeholders' systems (NM, ANSPs. AUs/CFSPs) together with the interoperability between the concerned systems shall be validated and coordinated well in advance before the implementation.

There is the need to coordinate/synchronize efforts (operational procedure and aircraft capabilities) between ANSPs, NM, Military Authorities, Civil and Military Airspace Users and CFSPs to ensure adequate performances for the return of investment and/or the start of operational benefits. Coordinated activities and implementation at State, FAB, Regional or Pan-European level are required.

The implementation of FRA is harmonized through the NM European Route Network Improvement Plan (ERNIP) and the Network Operations Plan following the Strategic Objectives and Targets set in the Network Strategic Plan and in the Network Manager Performance Plan. Free Route implementation strategy is a local decision coordinated at Network, FAB and Regional level.

Civil / Military Coordination

Civil-Military Coordination is beneficial for the exchange of data on airspace availability and on flight trajectories, i.e. Basic Flight Data (BFD) and Change Flight Data (CFD), other. Military ATC Systems shall be capable to process all required FRA Information.

Stakeholders considered as gaps	Civil-Military ANSPs, Network Manager	
Other stakeholders involved in the Family deployment	Civil-Military AUs	
Links to ICAO GANP ASBUs	B1-FRTO Improved Operations through Optimized ATS Routing	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AOM-0501 SESAR Release 5 AOM-0500 SESAR Release 5 AOM-0505 SESAR Release 9
	ATM Master Plan Level 3 (Edition 2019)	AOM21.2
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	FRA deployment is mandatory above FL305 at national level. Large scale deployments (e.g.: at FAB level, 24h, with minimum entry /exit conditions/constraints) are recommendable as producing most benefits that would be maximized considering future Pan-European FRA deployment. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	The initial implementation of FRA deployment with limitations e.g. FL, dimension, timing, functions and tools, may be planned as intermediate steps. However, this limited implementation cannot be considered as fulfilling the PCP requirements. To achieve the maximum benefits expected from FRA (even if not required from the PCP nor from this DP), implementation of FRA should be envisaged as fully completed only when cross-border implementation capability is available with all EU and participating neighbouring States. The implementation of the Family would require the identification and definition of features and operational concepts of the airspace, at least above FL305, where FRA will be implemented. Coordination with the Military Authority, NM, AUs/CFSPs shall be performed and with FAB partners / neighbouring states as necessary. **(MM1 – Free Route Airspace definition and coordination)**.	

	The appropriate testing and validation of Free Route Airspace structure and the correct Flight Plan management shall be performed **(MM2 Airspace Structure and Flight Plan Integration Validation).** In order for the Free Route Airspace to be implemented, fast and real-time simulations should be executed, if required, to assess and validate the impact of FRA. Whether its involvement is envisaged, NM could cooperate and validate these simulations **(MM3 – Fast and Realtime Simulation)**. Operational procedures shall be provided **(MM4 – Procedures available)** and Free Route Airspace shall be published into the relevant aeronautical documents **(MM5 – Publication of Free Route Airspace)**, all safety assessments required duly executed **(MM6 – Safety assessment),** appropriate training of ATCOs, shall be performed **(MM7 – Training of personnel)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM8 – Implementation completed)**.

4.4 AF #4 – Network Collaborative Management

Family 4.1.1 – STAM phase 1

4.1.1 – STAM Phase 1			
Main Sub-AF	S-AF 4.1 Enhanced Short Term ATFCM measures		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/11/2017

Description and Scope

The rigid application of ATFM regulations based on standard capacity thresholds as the pre-dominant tactical capacity measure needs to be replaced by a close working relationship between ANSP/FMP, NM and AU, which would monitor both the real demand, the effective capacity of sectors and their dynamic management by mean of different suitable configurations having taken into account the complexity of expected traffic situation.

In order to close the gap between ATC and ATFCM, local operational procedures need to be developed. The aim is to improve the efficiency of the system using flow management techniques close to the real-time operations with direct impact on tactical capacity management, occupancy counts and tactical action on traffic. The target of the Short Term ATFCM Measures (STAM) phase 1 is to replace En Route CASA regulations for situations when imbalances are manageable via STAM phase 1.

STAM phase 1 is mainly procedural implementation using the occupancy counts instead of entry counts for a better evaluation of overload, hot spot detection, limiting the need for regulations and implementation of STAM measure at local level. Each FMP needs to develop the STAM FCM procedure.

Additional tasks relevant to the STAM phase 1 scope shall encompass:

- development of consolidated STAM phase 1 concept of operation;
- development of operational guidance documentation;
- development of training package;
- development of harmonized operational procedures.

Interdependencies

STAM phase 1 is a predecessor of STAM phase 2, but the deployment of STAM phase 1 is not a mandatory task due to the fact that STAM phase 2 focuses on network workflow procedures and STAM phase 1 is more locally focussed.

Family 4.4.2 - Traffic Complexity tools: complexity assessment will facilitate the resolution of overload, hence increase efficiency of STAM measure.

Synchronization Needs

Support to STAM Phase 1 is completed from NM side, and is available to all FMPs via CHMI.

Synchronization with other families is also completed from NM side, complexity tool (scenario management) is available to all FMPs via CHMI.

Civil / Military Coordination

Yes, depending on the civil-military ATS organization

Stakeholders considered as gaps	ANSPs, Network Manager
Other stakeholders involved in the Family deployment	Airspace Users, Airports, Military Authorities

Links to ICAO GANP ASBUs	B0-NOPS Improved Flow Performance through Planning based on a Network-wide view	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	DCB-0205 Available
	ATM Master Plan Level 3 (Edition 2019)	FCM04.1[20]
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	The Family is considered as fully implemented within the PCP geographical scope. STAM Phase 1 would deliver additional capacity just relying on better utilisation of the available resources by moving from the hourly sector capacity rates to the occupancy counts. However, STAM phase 1 is not a mandatory step towards STAM phase 2.	
Family Deployment Approach	The implementation of the Family would require the development of the STAM phase 1 concept of operations, including the identification of local measures. Such development will potentially include the use of occupancy from NM tool (including the definition of OTMV), to be performed in coordination with Network Manager **(MM1 – STAM phase 1 concept of operations development)**. Following the concept of operations development, local procedures shall be developed and made available for operational use; such activity could be performed in coordination with neighbouring ACC and/or NM **(MM2 – Procedures available)**. The local operational documentation shall also be developed **(MM3 – Operational guidance documentation development)**. All safety assessments required duly executed **(MM4 – Safety Assessment)**. All operational personnel shall be duly trained **(MM5– Training)**.	

[20] The objective FCM04.1 is no longer included in the 2019 edition of the ATM Master Plan Level 3, as it was considered as "achieved" in its area of applicability at the end of year 2018. For further information, see also the status of implementation of Family 4.1.1 in the SDP Monitoring View 2019, accordingly considered as "fully implemented".

Family 4.1.2 – STAM Phase 2

4.1.2 – STAM Phase 2			
Main Sub-AF	S-AF 4.1 Enhanced Short Term ATFCM measures		
Readiness for implementation	High		
Initial Operational Capability	01/11/2017	**Full Operational Capability**	01/01/2022

Description and Scope

Tactical capacity management using STAM phase 2 requires the deployment of additional tool and procedures in order to ensure a close and efficient working relationship between NM, FMP and airspace users.

The STAM phase 2 tool should include occupancy traffic monitoring values (OTMV), hotspot detection and coordination. The enhancements shall mainly focus on:

- enhanced monitoring techniques (including hotspot management and complexity indicators);
- coordination systems (including B2B with local tools);
- what-if function (local measures, flight based, flow based and multiple measure alternative);
- network impact assessment.

Additional tasks relevant to the STAM Phase 2 scope shall encompass:

- development of consolidated STAM phase 2 concept of operation;
- development of operational guidance documentation;
- development of training package;
- development of harmonized operational procedures.

ANSPs, AUs, and Airport shall deploy:

- An interface between local STAM support systems (including AU trajectory optimisation) and the NM systems;
- and/or the STAM phase 2 application and services developed by NM;
- apply harmonized operational procedures, taking into account the STAM Phase 2 prerequisites such as the traffic information and flight predictability.

Interdependencies

Family 4.1.1, STAM phase 1, is a predecessor of Family 4.1.2, STAM phase 2, but the deployment of STAM phase 1 is not a mandatory task due to the fact that STAM phase 2 focuses on the network STAM workflow procedures where STAM phase 1 focuses on local STAM procedures.

Family 3.2.1 - Upgrade of ATM systems (NM, ANSPs, AUs) to support DCT and Free Route: in order to have enhanced data from upstream ANSP and be able to update trajectories, which in turn will enhanced the hotspot assessment, upgrade of ATM systems will enhance STAM.

Family 4.4.2 - Traffic Complexity tools: complexity assessment will facilitate the resolution of overload, hence increase efficiency of STAM measure.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Family 5.5.1 services as listed in the Appendix 1 of this Chapter.

Synchronization Needs

NM system readiness (STAM phase 2 tool for those who will use it, B2B or SWIM for the connection of the local tool and coordination) is a prerequisite for ANSP/AUs STAM phase 2 deployments.

Synchronisation is necessary between neighbouring ACCs. Involvement of AU is not mandatory but will enhance the solution.

Civil / Military Coordination		
Yes, depending on civil/military organization		
Stakeholders considered as gaps	Network Manager, ANSPs, Airport Operators, Airspace Users (CFSP)	
Other stakeholders involved in the Family deployment	Military Authorities	
Links to ICAO GANP ASBUs	B1-NOPS Enhanced Flow Performance through Network Operational Planning	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	DCB-0308 SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	FCM04.2
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Due to the FOC of the Family being 01/01/2022 and the rather tight schedule for implementing it on time, SDM recommends prioritising the implementation of this Family in order to ensure the PCP implementation is achieved in due time. The proposal should refer to the further NM developments for STAM phase 2. ANSPs and eventually AUs should consider submitting proposals for STAM phase 2 deployments (local tool and/or NM tool utilisation). It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach[21]	The implementation of the Family would require the development of the STAM phase 2 concept of operations, including the definition of roles and responsibilities of all actors, as well as the identification of the overall process. If required, local coordination with the military and/or with the airport should be performed **(MM1 – STAM phase 2 concept of operations development)**. The Network Manager should implement system improvements based on operational requirements in order to facilitate the coordination with local stakeholders **(MM2 – Upgrade of NM-systems (NM only))**. ANSPs shall install local tools capable to support STAM measure or to ensure the local implementation of the NM STAM stool. Military and airports could be involved in such installation **(MM3 – Installation of STAM support tool (not for NM))**. Network Manager shall define common procedure for coordination and consequentially develop operational guidance documentation for this	

[21] For further information concerning the mean duration of the Family implementation, please refer to the Short-Term Deployment Approach, as reported within Chapter 3.

	purpose **(MM4 – Development of operational guidance documentation for coordination (NM only))**. ANSPs and NM shall adapt and integrate their systems in order to allow the required data exchange and functionalities; it is worth noting that such activities are not required if NM tool is used **(MM5 – Integration of local STAM support systems with NM)**. ANSPs shall then issue local/sub regional procedures for the use of the local tool, in coordination with NM (and - if required - Airport and Military) **(MM6 – Local/sub regional procedures available (not for NM)**. All safety assessments required duly executed **(MM7 – Safety Assessment).** All involved operational staff from ANSPs and NM shall be duly trained **(MM8 – Training)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM9 – Implementation completed)**.

Family 4.2.2 – Interactive Rolling NOP

4.2.2 – Interactive Rolling NOP			
Main Sub-AF	S-AF 4.2 Collaborative NOP		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2022

Description and Scope

Network operations are driven by enhanced stakeholders' participation in a rolling cooperative process (Civil & Military airspace users, ANSPs, Airports, NM, outside EUR interfaces) by continuously sharing latest flight intentions resulting in demand and available capacity, defining measures in the network operations plan, realising the plan as a target by all actors taking into account operational updates, evaluating operations against performance targets and updating the plan.

This rolling view of the network situation (rolling NOP) and the support to the collaborative processes is based on an information management platform, accessible online by all stakeholders for consultation, (not only passive but including dialogue opportunities for sharing of evaluations and issues) and updated as and when needed, in a secure and tailored way.

An initial implementation of the Interactive Rolling NOP was achieved through the deployment of the NOP Portal, providing a limited initial view of the Network Situation, with very limited collaboration and tailoring capabilities.

The scope of this Family consists in the implementation of a platform that uses the state-of-the-art technologies for creation of a Virtual Operations Room for the physically distributed European ATM Network Operations, in support of the Collaborative NOP.

This platform supports the network collaborative rolling processes from strategic to real-time operations, including capabilities for online performance monitoring integrated and feeding back into the collaborative network planning. Also, the platform provides access to post-operational data for offline analysis and performance reporting.

The platform shall provide SLA management capabilities, based on a holistic view of the users and their organisations, their interaction with the system and on the monitoring of the SLA adherence by the different parties.

The platform will provide both a workplace tool, as well as B2B interfaces following SWIM standards, to allow integration in the stakeholders' own systems. Information and dialogue tools shall be accessed anytime, anywhere via an ATM Information Portal. Access to information is done in a secure way, tailored according the stakeholders needs and subject to access control rules, so that only those who have an operational need to access particular information are able to do so.

Interdependencies

Family 3.1.2 will be enhanced by the Interactive Rolling NOP.

Family 4.2.4 - AOP/NOP information sharing will be enhanced by the Interactive Rolling NOP.

Family 4.1.2 - STAM phase 2 need the new plat form to be deployed to be used by the ANSP wanting to use NM tool.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Family 5.5.1 services as listed in the Appendix 1 of this Chapter.

Many other families where the quality of data coming from outside the ANSP area can profit from a better NM system to access to Network information.

Synchronization Needs

This Family is about exchange of information, even if no synchronization is needed per se: the reception of information from stakeholders is prerequisite to the sharing.

Civil / Military Coordination		
Yes, especially for interface requirement		
Stakeholders considered as gaps	Network Manager, ANSPs, Airspace Users (CFSP)	
Other stakeholders involved in the Family deployment	Airport Operators, Military Authorities	
Links to ICAO GANP ASBUs	B1-NOPS Enhanced Flow Performance through Network Operational Planning	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	DCB-0103-A SESAR Release 5 DCB-0102 Available
	ATM Master Plan Level 3 (Edition 2019)	FCM05
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	It will be a basic platform for info sharing between all stakeholders. IPs proposals are expected by NM (as provider of the platform) but in terms of deployment the different stakeholders are impacted, as processes need to be put in place locally to use the platform. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	The implementation of the Family would require the Network Manager to provide B2B and HMI interfaces with other OPS actors for any relevant data exchange needed for ATM Functionalities 4 **(MM1 – NM to deploy Interactive Rolling NOP platform (NM only))**. Network Manager shall also define procedures and provide documentation for the use of the system **(MM2 – NM to develop guidance material (NM only))**. ANPSs shall then define and make available procedures for the use of interfaces; it is worth noting that airport and military could be also involved if required **(MM3 – Procedures available at local side (not for NM))**. All involved operational staff from ANSPs, NM and – if required airports and militaries – shall be duly trained **(MM4 – Training)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.	

Family 4.2.3 – Interface ATM systems to NM systems

4.2.3 – Interface ATM systems to NM systems			
Main Sub-AF	Sub-AF 4.2 Collaborative NOP		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2022

Description and Scope

This Family addresses the message exchange between NM systems, ANSPs ATM system and AU/FOC /WOC flight plan filing systems in respect of collaborative flight planning, improving flight plan distribution and enhanced tactical flow management.

The exchanges of following messages between NM, ATM and AU/FOC systems are addressed by this Family as:

- ATC Flight Plan Proposal (AFP)
- ATC Flight Plan Change message (ACH)
- ATC Flight Plan message (APL)
- First System Activation (FSA)
- Correlated Position Report (CPR)
- eFPL based on FF-ICE (enhanced Flight Plan)
- Improved OAT Flight Plan

The eFPL in FIXM format will include the planned 4D trajectory of the flight as well as flight performance data in addition to ICAO 2012 FPL data. The first phase that will be implemented should address only the exchange of eFPL information between AUs and NM. The transmission to ANSP (flight plan distribution) will be implemented when transition to FF-ICE provisions is achieved, and is not considered as mandatory for PCP completion. ANSPs automatically provide AFP message to NM for following events:

- Missing flight plan
- Change of route
- Diversion
- Change of flight rules or flight type
- Change of requested cruising level
- Change of aircraft type
- Change of aircraft equipment

The local ATM system shall be capable to process APL and ACH messages sent by IFPS in order to exploit the full benefits of AFP distribution to NM. NM needs to integrate the received AFP within NM systems. ANSPs need also to provide CPR and FSA messages to NM system (only a few pending ANSPs). eFPL will be processed by the AU flight planning systems and sent to IFPS.

As a first step towards the implementation of the Mission Trajectory concept, military environmental data will be processed by FDPS and IFPS (reference Sub-Family 3.1). Despite not being in the PCP, an Improved OAT FPL should be considered as an enabler processed by IFPS to describe the trajectory including the information about ARES to be used, this is in order to have a more comprehensive view of airspace demand.

Interdependencies

Family 3.2.1 will be enhanced by the interface of ATM systems to NM systems.

Family 4.4.2 – Traffic Complexity tools. Enhanced data quality will enhance the complexity assessment.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Family 5.5.1 and Family 5.6.1 services as listed in the Appendix 1 of this Chapter.

Synchronization Needs
Synchronisation across AUs is desirable for eFPLs in order to have a noticeable impact in providing the rolling nature of the NOP. For FF-ICE deployment, the synchronisation between NM, AU and eventually ANSP is required for the development and deployment phase. Synchronisation is required for AFP between NM and ANSPs.
Civil / Military Coordination
Yes, required.

Stakeholders considered as gaps	ANSPs, Airspace Users (CFSPs), Network Manager, Military Authorities	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B1-FICE Increased Interoperability, Efficiency and Capacity through Flight and Flow Information for a Collaborative Environment Step-1 (FF-ICE/1) application before Departure B1-NOPS Enhanced Flow Performance through Network Operational Planning	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	IS-0102 Available AUO-0203 SESAR Release 5 AUO-0215 SESAR 2020 Wave 2
	ATM Master Plan Level 3 (Edition 2019)	FCM03, FCM08
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	The exchanges of collaborative flight planning messages are essential for improving the Pan-European flight predictability. It should be considered to prime importance to address the existing gaps for the provision of CPRs, AFP and FSA messages to NM. ANSPs which not yet provide these messages to NM should consider submitting IP proposal. NM and AUs should consider submitting IP proposal for eFPL based on FF-ICE and iOAT flight plan. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	NM system need first to be updated to be able to receive data from external partner and send updated data (**MM0 - System upgrade to receive / process / provide messages from/to ANSPs and AUs (NM only)**). The implementation of the Family would require ANSPs (and - when needed – airports and Airspace Users) to upgrade their systems in order to generate messages to NM and for NM to receive and process, and distribute as required (including FSA, CPR, AFP, APL, ACH messages) and eFPL from Airspace Users. The involvement of militaries is necessary for GAT (eFPL) and OAT FPL **(MM1 – System upgrade to send messages to NM)**.	

	ANSPs (and - if needed - airports) are also required to upgrade their systems in order to receive and process messages coming from Network Manager, using the guidance material developed by NM for Family 4.2.2 **(MM2 – System upgrade to receive messages from NM)**. ANSPs (and airports - if needed) shall perform pre-implementation trials **(MM3 – Integration test with NM)**. Operational procedures for the use of new messages shall be defined and made available **(MM4 – Procedures available)**. All safety assessments required duly executed **(MM5 – Safety Assessment)** and all operational/technical staff involved shall be duly trained **(MM6 – Training)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM7 – Implementation completed)**.

Family 4.2.4 – AOP/NOP information sharing

4.2.4 –AOP/NOP information sharing			
Main Sub-AF	Sub-AF 4.2 Collaborative NOP		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2022

Description and Scope

The Airport element that reflects the operational status of the Airport and therefore facilitates Demand and Capacity Balancing is the Airport Operations Plan (AOP), described in Family 2.1.4. The AOP connects the relevant stakeholders, notably the Airspace Users' Flight Operations Centres (FOC) and Wing Operations Centres (WOC). It contains data and information relating to the different status of planning phases and is in the format of a rolling plan, which naturally evolves over time.

The AOP is a single, common and collaboratively agreed rolling plan available to all airport stakeholders whose purpose is to provide common situational awareness and to form the basis upon which stakeholder decisions relating to process optimization can be made.

In order to improve the European ATM network performance, notably capacity and flight efficiency through exchange, modification and management of trajectory information there is a clear need for information sharing between the AOP and the NOP (Network Operation Plan).

The integration of AOP and NOP provides a rolling picture of the network situation used by stakeholders to prepare their plans and their inputs to the network CDM processes (e.g. negotiation of airspace configurations). As such the collaborative NOP will be fully integrated in ATM stakeholders' planning processes and working methods.

The creation and maintenance of the AOP as well as the integration and the consistency with the NOP involves a large number of stakeholders, with different roles and responsibilities: the airspace users including the flight crews and the AU FOC/WOC, the Airport Operators, the Air Navigation Service Providers, the Network Manager and the MET services.

The AOP/NOP information sharing is the technical data layer on the collaborative NOP. The output of SESAR is relatively mature and further refinement is on-going driven by NM. Currently data-exchange is achieved via AFTN, which is to be replaced over time by cooperative network information services, using the yellow SWIM Profile. Details have to be defined in collaboration between the NM and the implementing stakeholders.

Interdependencies

Family 2.1.4 - Initial AOP Information is a prerequisite to be integrated in the AOP/NOP.

Family 4.3.1 - The AOP-NOP link is required to exchange ground AOP TTAs with NM.

Family 4.2.2 - Will be enhanced by the AOP/NOP information sharing.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Family 5.4.1 and Family 5.5.1 services as listed in the Appendix 1 of this Chapter.

Synchronization Needs

Due to the rolling and sharing nature of the information contained in the AOP/NOP, Family 4.2.4 is to be synchronized between NM, the Airport and the ANSPs.

Civil / Military Coordination

Yes, depending on civil/military ATS organization

Stakeholders considered as gaps	Network Manager, Airport Operators	
Other stakeholders involved in the Family deployment	ANSPs, Military Authorities, MET Service Providers,	
Links to ICAO GANP ASBUs	B0-NOPS Improved Flow Performance through Planning based on a Network-wide view	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	DCB-0103-A SESAR Release 5 AO-0801-A SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	FCM05
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Due to the FOC of the Family being 01/01/2022 and the rather tight schedule for implementing it on time, SDM recommends prioritizing the implementation of this Family in order to ensure the PCP implementation is achieved in due time. In order to achieve full performance of Family 4.2.4, it is recommended to implement Family 2.1.4 since it is part of the critical initiatives to resolve and mitigate the impacts of current capacity constraints and potential bottlenecks, which might hinder the overall performance at network level. For that reason, it is highly recommended that NM define the interface between AOP and NOP to be in a position to deploy AOP/NOP integration as soon as AOP is available. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View, considering also the Gap Analysis of Family 2.1.4.	
Family Deployment Approach[22]	The implementation of the Family would require the Network Manager to adapt their system to receive and process information coming from AOP and distribute as required to operational stakeholders **(MM1 – NM to develop interface for AOP integration)**. Network Manager shall also develop the required procedures and the associated documentation to support the utilisation of interfaces **(MM2 – NM to develop operational guidance documentation)**. All interested systems shall be updated in order to allow the system-to-system data exchange and to enable all necessary functionalities. Military could be involved in such activities **(MM3 – Integration of AOP with NOP)**. The procedures for generating and/or using messages shall be elaborated, with the involvement of ANSPs and Militaries, if necessary **(MM4 – Procedures available)**. All involved operational staff shall be duly trained **(MM5 – Training)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM6 – Implementation completed)**.	

[22] For further information concerning the mean duration of the Family implementation, please refer to the Short-Term Deployment Approach, as reported within Chapter 3.

Family 4.3.1 – Target Time for ATFCM purposes

4.3.1 – Target Time for ATFCM purposes			
Main Sub-AF	Sub-AF 4.3 CTOT to Target Time for ATFCM Purposes		
Readiness for implementation	High		
Initial Operational Capability	01/01/2017	**Full Operational Capability**	01/01/2022

Description and Scope

First Step:

NM systems should transmit the calculated target time at the most penalising regulation reference point in addition to CTOT to all concerned users. Those users should be able to manage this new feature and potential system upgrades should be foreseen.

Second step - Validation with iStream (TTA in planning for Arrival management) in 2016 and PJ24 (Network Collaborative Management mainly TTA in planning for Airport management) in 2018-2019):

This second step, particularly in case of unique Airport regulation, either linked to ground (AOP) or arrival sequencing (AMAN, extended-AMAN), will permit an early partial optimisation from a local point of view via the transmission of local TTA/TTO to NM.

NM will be in charge of assessing the network impact leading eventually to coordination with the originator, and of transmission of CTOT and TTA/TTO to the concerned flight. This process will be limited to the planning phase and transmission of CTOT and updated CTOT as per standard processes. It will also enhance the slot swapping process.

Interdependencies

Family 4.1.2 - STAM phase 2 (coordination with originator of TT).

Family 2.1.4 via integration in Family 4.2.4 for airport willing to use this feature for TTA.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Family 5.5.1 services as listed in the Appendix 1 of this Chapter.

Synchronization Needs

For step 2 of this Family, coordination between the originator or the TT and NM is needed.

Coordination between NM and originator of TT can be made via STAM phase 2 or AOP/NOP integration.

Civil / Military Coordination

Not foreseen

Stakeholders considered as gaps	Network Manager, Airspace Users (CFSP)
Other stakeholders involved in the Family deployment	ANSPs, Airport Operators, Military Authorities

Links to ICAO GANP ASBUs	B0-NOPS Improved Flow Performance through Planning based on a Network-wide view	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	DCB-0208 SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	FCM07
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	After a first step for the transmission by NM of target time on the constrained area on top of CTOT, airport and ANSP could consider submitting IP's proposal for the deployment of this Family. AUs need to update their system to take target times into account in their planning procedure. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	The implementation of the Family would require the Network Manager to provide description and guidance upon the interfaces between the NM systems and other systems (e.g. AU), as well as the related procedures **(MM1 – NM to provide guidance on use of target time)**. All systems of the involved stakeholder dedicated to Target Times processing and use shall also be updated **(MM2 – System upgrades)**. Procedures for all involved actors (NM/ANSPs and airports for planning purposes) to facilitate Target Times for ATFCM purposes shall be developed and made available **(MM3 – Procedures available)**. All safety assessments required duly executed **(MM4 Safety Assessment)**. All involved operational staff shall be duly trained **(MM5 – Training)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM6 – Implementation completed)**.	

Family 4.3.2 – Reconciled target times for ATFCM and arrival sequencing

4.3.2 – Reconciled Target Times for ATFCM and Arrival Sequencing			
Main Sub-AF	Sub-AF 4.3 CTOT to Target Time for ATFCM Purposes		
Readiness for implementation	Low		
Initial Operational Capability	01/01/2019	**Full Operational Capability**	01/01/2022

Description and Scope
The scope of this Family contains the process, procedure and system upgrades related to the reconciliation of multiple local Target Time constraints, coming from Airport (AOP), ANSP (either AMAN/extended AMAN or en-Route) or Network DCB process. To this end, the potential solution will be coordinated and disseminated to the different stakeholders (supported by the Network CDM Information Platform and within the context of the NOP) at the Local and Network levels. Once coherence and agreement is achieved, the implementation will be initiated. Considering the current status of development work, the concept still needs to be validated at SJU level.
Interdependencies
Family 1.1.2 - Extended AMAN could be able to use issued TT. Family 2.1.4 - Initial Airport Operations Plan. Family 4.1.2 - STAM phase 2. Family 4.3.1 - Target Time for ATFCM purposes needs to be adopted before more complex TT scheme can be deployed. As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Family 5.6.2 services as listed in the Appendix 1 of this Chapter.
Synchronization Needs
Coordination with all stakeholders throughout the flight is required, that is the reason why the Family is still not fully validated. Synchronisation required between NM, AUs, Airport Operators and ANSP to ensure that the Full Family benefits are achieved.
Civil / Military Coordination
Yes, depending on civil/military ATS organization and concept of operation.

Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users(CFSP), Network Manager
Other stakeholders involved in the Family deployment	Military Authorities
Links to ICAO GANP ASBUs	B1-NOPS Enhanced Flow Performance through Network Operational Planning

ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	DCB-0213 SESAR 2020 Second Wave DCB-0208 SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	FCM07
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Considering the current status of development work, SDM considers that the concept still needs to be validated at SJU level.	
Family Deployment Approach	This Family is not yet fully validated. The implementation of the Family would require the definition of the concept of operations for reconciled target times for ATFCM and arrival sequencing; such activities shall include - where necessary - the local coordination with the military **(MM1 – Concept of operation defined)**. NM shall upgrade their system to re-conciliate the different target time, as required by the defined concept **(MM2 – NM system upgrade for re-conciliated TT (NM only))**. NM shall also produce the proper guidance documentation on the use of re-conciliated target time and the definition of the interfaces for system-to-system data exchange **(MM3 – NM to develop guidance material for re-conciliated TT (NM only))**. System shall be upgraded in order to process re-conciliated Target Time and to allow their use **(MM4 – System upgrades available to process re-conciliated target time)**. Procedures for all involved operational stakeholders to operate re-conciliated Target Times for ATFCM purposes shall be made available **(MM5 – Procedures available)**. A safety assessment for associated operational and system changes shall be performed successfully **(MM6 – Safety Assessment)** and all operational/technical staff involved shall be duly trained **(MM7 – Training)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM8 – Implementation completed)**.	

Family 4.4.2 – Traffic Complexity tools

4.4.2 – Traffic Complexity Tools			
Main Sub-AF	Sub-AF 4.4 Automated Support For Traffic Complexity Assessment		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2022

Description and Scope

The traffic complexity tools continuously monitor sector demand and evaluate traffic complexity (by applying predefined complexity metrics) according to a predetermined qualitative scale.

The predicted complexity coupled with traffic demand enables ATFCM to take timely action to adjust capacity, or request the traffic profile changes in coordination with ATC and airspace users.

The rigid application of ATFCM regulations based on standard capacity thresholds as the pre-dominant tactical capacity measure needs to be replaced by a close working relationship between ANSPs and Network Manager, which would monitor the real demand, the sector capacity and their dynamic management.

The scope of this Family shall include:

- ANSP to implement Local Traffic Complexity tools and procedures. The Traffic Complexity tool continuously monitors and evaluates current and expected traffic loads and estimates controller's workload. It provides a support in the determination of solutions in order to plan airspace, sectors and staff to handle the predicted traffic. It is suggested that ANSPs develop concept for the complexity tools utilisation before considering the procurement/upgrades of ATM systems with this functionality
- The local complexity tools need to receive process and integrate the EFD provided by NM. This is required in order to supplement the local traffic counts with the flight plan data from ETFMS;
- The NM systems adaptation activities deal with improving the quality of the planned trajectory (processing of ATC information part of 4.2.3 Family, processing of eFPL and improved OAT FPL information part of 4.2.3 Family, support to mixed mode operations, Implementation of traffic count methodologies that do not impact trajectory calculation) thus enhancing NM complexity assessment.

Implementation of scenario management tools in support of traffic complexity will rely on the planned trajectory and allows simulating options optimising the use of available capacity.

This will help NM operations identify possible mitigation strategies to be applied at network or local level, in coordination with FMPs and airspace users if applicable.

Interdependencies

Family 3.1.4 will be enhanced by the traffic complexity tools.

Family 4.1.1 - STAM Phase 1 and Family 4.1.2 - STAM Phase 2: complexity assessment will facilitate the resolution of overload, hence increase efficiency of STAM measure.

Family 4.2.3 - Interface ATM system to NMS and 4.2.4 AOP/NOP integration. The provision of enhanced trajectory data will improve flight plan management.

Family 3.2.1 – Upgrade of ATM systems (NM, ANSPs, AUs) to support DCT and Free Route and Fam 3.1.4 Dynamic Airspace Configuration will be enhanced by the traffic complexity tools.

As soon as SWIM Families 5.2.2 and 5.2.3 are implemented locally and at the information exchange partner, the information sharing shall be performed using SWIM standards and services, specifically through Family 5.5.1 services as listed in the Appendix 1 of this Chapter.

Synchronization Needs

NM tool for states which will use NM tool. EFD data (from NM) need to be managed by ANSP

Civil / Military Coordination		
Yes, depending on civil/military ATS organization		
Stakeholders considered as gaps	ANSPs, Network Manager	
Other stakeholders involved in the Family deployment	Military Authorities	
Links to ICAO GANP ASBUs	B1-NOPS Enhanced Flow Performance through Network Operational Planning	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	CM-0103-A SESAR Release 5 CM-0101 Available IS-0102 Available
	ATM Master Plan Level 3 (Edition 2019)	FCM06
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Taking into account that complexity tools need to be deployed in collaboration between ANSPs and NM, particularly at ATC planning level, the IP proposal should be mainly focused on ANSPs and NM system upgrades. It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	The implementation of the Family would require the development and definition of the concept of operations, encompassing the overall process, including roles and responsibilities of the involved stakeholders. Such activity could require local coordination with the military, if necessary **(MM1 – Concept of operations developed)**. Network Manager shall develop and provide guidance documentation as basis for required operational procedures and systems **(MM2 – Operational guidance documentation developed (only for NM))**. NM shall adapt its systems in support of complexity assessments, including the exchange of associated data **(MM3 – Adaptation of NM (only for NM))**. Local stakeholders shall implement complexity tool in the local systems, or adapt the NM tool for the required usage **(MM4 – Installation of local complexity tool (not for NM))**. If required for a smooth exchange of data and information, the implementation of system-to-system interfaces (including EFD) shall be performed **(MM5 – Integration of local tool with NM via EFD)**. Procedures for operational stakeholders for facilitating the use of the tool shall be defined and made available **(MM6 – Procedures available)**. All involved operational staff shall be duly trained **(MM7 - Training)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM8 – Implementation completed)**.	

4.5 AF #5 – Initial SWIM

Family 5.1.1 – PENS 1: Pan-European Network Service version 1

5.1.1 – PENS1: Pan-European Network Service version 1			
Main Sub-AF	Sub-AF 5.1 Common Infrastructure Components		
Readiness for implementation	High		
Initial Operational Capability	Before 2014 PENS1 has been deployed from 2009 by NM and ANSPs	**Full Operational Capability**	31/12/2019 PENS1 is expected to end in December 2019 before being replaced by NewPENS, but requests to become a PENS1 user can no longer be granted due to the transition period of the service to NewPENS.

Description and Scope
An Internet Protocol (version 6) Network connectivity is necessary to support the SWIM information exchanges. The current PENS (Pan European Network Service), called PENS1, supports the exchanges of the current ATM information based on Internet Protocol (versions 4, 6). PENS1, provided by SITA, is expected to terminate in December 2019, but a new PENS, called NewPENS, is planned to be deployed to replace PENS1. Deployment is foreseen from the beginning of 2018 with a transition period (2018-end 2019) to guarantee the continuity of operations. The PCP stipulates *"To support the blue SWIM TI Profile (for Flight Object), very high and high capacity centres shall be connected to Pan-European Network Services (PENS)".* So ANSPs, planning to implement IOP FO, have to be or become PENS user. This Family aims at implementing projects for ANSPs not yet PENS1 users. Coordination with similar initiatives in other ICAO Regions is required for worldwide interoperability, especially with the US and Canada.
Interdependencies
Please refer to the Short-Term Deployment Approach (see details in Section 3) for information regarding dependencies to other AF5 families.
Synchronization Needs
The synchronization and coordination is performed by the PSSG (PENS Steering Group) and the PMU (PENS Management Unit), the main bodies of the PENS1 Governance. Any PENS user has a representative in PSSG, when entering PENS by signing the PENS CPA (Common Procurement Agreement) and the dedicated Amendment.
Civil / Military Coordination
Where States have agreed or intend to share information between civil and military ANSPs via PENS it is essential that migrations to IP Network Services are coordinated between all parties.

Stakeholders considered as gaps	ANSPs, Network Manager, Military ANSPs who require direct interconnections to civil ANSPs
Other stakeholders involved in the Family deployment	None

Links to ICAO GANP ASBUs	B1-SWIM Performance Improvement through the Application of System-Wide Information Management (SWIM)	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	CTE-C06a (PENS-Phase 1) Available
	ATM Master Plan Level 3 (Edition 2019)	None
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	In 2018 and 2019 PENS is undergoing a transition period from PENS1 to NewPENS. During that time, it is no longer possible to become a PENS1 user, while requests to become NewPENS user cannot be met until the end of 2019. For this reason, any ANSP, not yet PENS user, planning to use PENS, e.g. for implementing IOP FO, has to wait for the availability of the NewPENS service (applications can be made at any time, but the service will not be delivered before the end of 2019). PENS is also able to support all the ATM information exchanges even if the Commission Implementing Regulation (EU) No 716/2014 is requiring PENS only for the Blue Profile required for Flight Object. So any OS, not yet PENS user, could present an IP to become a PENS user.	
Family Deployment Approach	The implementation of the Family would require the signature of both the PENS1 CPA (Common Procurement Agreement) with EUROCONTROL and the Amendment with the Network Service Provider **(MM1 – PENS1 CPA (Common Procurement Agreement) and Amendment signed)**. The Network Service Provider shall then install its routers in the Operational Stakeholder premises in order for the Operational Stakeholders to gain access to PENS1 **(MM2 – PENS1 access point(s) installed)**, and connect with the Operational Stakeholder IP Network in a secure manner **(MM3 – PENS1 connection(s) installed including security measures)**. Before the start of operational use, the planning of end-to-end network services deployment (test, validation, operation) shall be completed with other Operational Stakeholders, such as NM, ANSPs, etc. **(MM4 – Planning of the Network Services)**. The execution of such activities is expected to lead to the start of permanent operational use meaning that all end-to-end network services shall be in operation, supporting Yellow and Blue Profiles **(MM5 – Network Services in Operation)**. When implementing SWIM and its prerequisites each stakeholder has to take into account the requirements stemming from the safety and security assessment at functional level required by their respective NSA.	

Family 5.1.2 – NewPENS: New Pan-European Network Service

5.1.2 – NewPENS: New Pan-European Network Service			
Main Sub-AF	Sub-AF 5.1 Common Infrastructure Components		
Readiness for implementation	High		
Initial Operational Capability	01/06/2018	**Full Operational Capability**	01/01/2025

Description and Scope

An Internet Protocol (version6) Network connectivity is necessary to support the SWIM information Exchanges. NewPENS (New Pan European Network Service) will support exchanges of information based on Internet Protocol. NewPENS will replace PENS1, which will terminate in December 2019. The PCP stipulates "*To support the blue SWIM TI Profile (for Flight Object), very high and high capacity centres shall be connected to Pan-European Network Services (PENS)*". So civil and military ANSPs, planning to implement IOP FO, have to be NewPENS users.

Although the Yellow Profile has less demanding QoS requirements than the Blue Profile, Operational Stakeholders can opt for using NewPENS for information exchanges using the Yellow Profile. It will be up to Stakeholders, according to their requirements, to select the public Internet or NewPENS. After the signature of the NewPENS CPA (Common Procurement Agreement) by Operational Stakeholders in the end of 2015, NewPENS has been set-up with a dedicated governance. The NewPENS governance comprises:

1. Three bodies, representing all the Operational Stakeholders having signed the CPA, at the executive level, from top to bottom:
   a. A Top Management Body (TMB) at the CEO level.
   b. A PENS Executive Board (PEB) at the Director' level.
   c. PENS Boards at the Operational and Technical level representing the different types of Operational Stakeholders (NM, ANSPs, …).
2. One EUROCONTROL unit at the Management level, the PMU (PENS Management Unit) is responsible for managing the necessary procurements and the related contracts with the future providers of Network Services and interfacing the NewPENS users.
3. One PENS Technical Center (PTC) composed of some Operational Stakeholder representatives is responsible for defining and driving the technical and operational NewPENS evolution.
4. PENS Operational Center responsible for providing the help desk services between the NewPENS users and the NewPENS providers to guarantee safe and secure continuity of service 24/7.
5. Network Service Provider(s) (contractor(s)) providing the Internet Protocol Services to the PENS Users according to the required SLAs (Service Level Agreements).

Following a common procurement action, EUROCONTROL and forty-one industry partners, primarily air navigation service providers (ANSPs), on 17th April 2018 launched a contract with BT for the provision and management of a secure and highly resilient New Pan-European Network Service (NewPENS).

A transition phase to migrate from PENS1 to NewPENS is then expected from 2018 to end 2019, the latter being the date of the full operation of NewPENS and of the PENS1 termination. The coordination with similar initiatives in other ICAO Regions is required for worldwide interoperability, especially with the US and Canada.

Interdependencies

Please refer to the Short-Term Deployment Approach (see details in Section 3) for information regarding dependencies to other AF5 families.

Synchronization Needs

The synchronization and coordination will be performed by the NewPENS Governance bodies in place from the beginning of 2016. Every NewPENS user has a representative in the NewPENS Governance bodies (TMB, PEB, PENS Boards), when entering NewPENS by signing the NewPENS CPA (Common Procurement Agreement) and - after the contract is awarded - the dedicated Amendment.

Civil / Military Coordination		
Where States have agreed or intend to share information between civil and military ANSPs via the NewPENS it is essential that migrations to IP Network Services are coordinated between all parties.		
Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users, Network Manager, Military Authorities, MET Service Providers	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B1-SWIM Performance Improvement through the Application of System-Wide Information Management (SWIM)	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	CTE-C06b (PENS-Phase 2) Available
	ATM Master Plan Level 3 (Edition 2019)	COM12
Cyber security Requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Within the framework of CEF 2015 and CEF 2016 Calls, several Stakeholders have become NewPENS users. Any operational stakeholder not yet NewPENS user is invited to propose an IP for becoming a NewPENS user. NewPENS is able to support all the ATM information exchanges even if the Commission Implementing Regulation (EU) No 716/2014 is requiring PENS only for the Blue Profile intended for the exchange of Flight Object.	
Family Deployment Approach	The implementation of the Family would require the signature of both the NewPENS CPA (Common Procurement Agreement) with EUROCONTROL and the Amendment with the Network Service Provider **(MM1 – NewPENS CPA (Common Procurement Agreement and Amendment signed**). The Network Service Provider shall then install its routers in the Operational Stakeholder premises in order for the Operational Stakeholder to gain access to NewPENS **(MM2 – NewPENS access point(s) installed)** and connect with the Operational Stakeholder's IP Network in a secure manner **(MM3 – NewPENS connection(s) installed including security measures)**. Before the start of operational use, the planning of end-to-end network services deployment including the possible transitions from PENS1 to NewPENS (test, validation, operation) shall be organised with other Operational Stakeholders, such as NM, ANSPs, AUs, Airport Operators, etc. **(MM4 – Planning of the Network Services)**. The execution of such activities is expected to lead to the start of permanent operational use, meaning that all end-to-end network services shall be in operation, supporting Yellow and Blue Profiles **(MM5 – Network Services in Operation)**. When implementing SWIM and its prerequisites each stakeholder has to take into account the requirements stemming from the safety and security assessment at functional level required by their respective NSA.	

Family 5.1.3 – Common SWIM Infrastructure Components

5.1.3 – Common SWIM Infrastructure Components			
Main Sub-AF	Sub-AF 5.1 Common Infrastructure Components		
Readiness for implementation	High		
Initial Operational Capability	01/06/2016 For starting the SWIM Governance Structure and Processes and SWIM Registry	**Full Operational Capability**	01/01/2025

Description and Scope

Within the Commission Implementing Regulation (EU) No716/2014 the SWIM Infrastructure has been split in two parts:

- The common components § 5.1.1. Common infrastructure components.
- The stakeholders' components § 5.1.2. SWIM Technical Infrastructure and Profiles.

According to Commission Implementing Regulation (EU) No 716/2014 § 5.1.1. the **Common SWIM Infrastructure Components** are:

— ***The registry****, which shall be used for publication and discovery of information regarding service consumers and providers, the logical service and information models, SWIM enabled services (Service Implementations), business, technical, and policy information.*

— ***Public Key Infrastructure*** *(PKI), which shall be used for signing, emitting and maintaining certificates and revocation lists; The PKI ensures that information can be securely transferred.*

The Commission Implementing Regulation (EU) No 716/2014 also stipulates that *SWIM comprises standards, infrastructure and* ***governance*** *enabling the management of information and its exchange between operational stakeholders via interoperable services*.

The current Family is dealing with the **common** components of SWIM, where "Common" refers to one common system or one common set of rules to be deployed for the **entire** geographical scope mandated by the Commission Implementing Regulation (EU) No 716/2014.[23] This Family comprises the **SWIM Governance and the SWIM registry** (Family 5.2.2 "Stakeholder SWIM Infrastructure Components" (5.2.2) is dealing with the dedicated **stakeholders**' components).

The **Public Key and Security Infrastructure** is dealt with in two separate Families, Family 5.1.4 for the common part and Family 5.2.3 for the stakeholder implementation.

The scope of this Family is the implementation of the SWIM common components SWIM Governance and SWIM registry. The **SWIM Governance** consists of bodies including civil and military stakeholders and of processes that together support the operational stakeholders in their implementation of SWIM services, as well as the controlled evolution of SWIM. SWIM governance:

- manages the common components, in particular the registry;
- contributes to the elaboration of SWIM standards;
- maintains the SWIM Compliance Framework and governs the compliance assessments;
- devises the policies for the provision and the consumption of the SWIM services, i.e.
  - the compliance policy,
  - the information security policy and
  - the service policy.
- devises and carries out the processes for the evolution of SWIM, e.g. change management, the service lifecycle, etc.

A **SWIM registry** managed by the SWIM Governance bodies, is the common information repository. It allows the discovery of existing services by providing the service catalogue (list of service models and service implementations).

[23] Note that by contrast, components that are common to several sites or systems of one stakeholder belong to Sub-AF 5.2

Furthermore, it supports the implementation of SWIM by providing reference documents such as the Eurocontrol SWIM specifications, the ATM Information Reference Model (AIRM), SWIM TI Profile definitions, compliance framework and criteria, SWIM Governance policies, etc.

For worldwide interoperability, the coordination with similar initiatives in other ICAO Regions is required, especially with the US who are moving forward with the deployment of NextGen.

In particular coordination on the following activities is considered essential:

- Interoperable SWIM registries
- Services that are in common
- An agreed service lifecycle
- Mediation services able to translate information syntactically or semantically between different regions

Interdependencies

Please refer to the Short-Term Deployment Approach (see details in Section 3) for information regarding dependencies to other AF5 families.

Synchronization Needs

Strong coordination is necessary between all stakeholders to implement the common components starting with agreed SWIM Governance (consisting of the structure and the processes) and then further components – in particular the registry – under the steering of the SWIM Governance. Coordination with other ICAO regions is required since a majority of the information exchanged via SWIM requires exchange beyond Europe.

Civil / Military Coordination

Military must be represented in the SWIM Governance bodies and their specific needs must be considered in the identified processes

Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users, Network Manager, Military Authorities, MET Service Providers	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B1-SWIM Performance Improvement through the Application of System-Wide Information Management (SWIM)	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	IS-0901-A SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	INF08.1, INF08.2
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	An implementation initiative engaging a wide number of stakeholders from all categories (ANSPs, AOs, AUs) has already been launched, addressing the setup and initial operation of a SWIM Governance structure and the associated processes. This initiative will refine and implement the entire SWIM Governance framework initiated in SESAR1, which has a direct impact on all IPs related to the implementation of AF5, specifically the Families 5.1.3, 5.1.4, 5.2.2, 5.2.3,	

	5.3.1, 5.4.1, 5.5.1, 5.6.1 and 5.6.2. For this reason, stakeholders are invited to express their interest in joining the SWIM Governance structure.
Family Deployment Approach	For implementing the European SWIM Governance, a group of stakeholders has joined forces and has submitted an implementation project to INEA in response to CEF Transport Calls 2016. It is the task of this project to lay the groundwork for a common European SWIM Governance for the sake of all stakeholders. The project will prepare the deployment of SWIM Governance and put the organization and its processes in place. Once this is finished, the project will close and the SWIM Governance shall be operated. The implementation of the Family requires collaboration between the above-mentioned European SWIM Governance organization on the one hand and the operational stakeholders deploying SWIM locally on the other hand. A number of implementation steps and associated milestones have to be undertaken solely by the SWIM Governance project; these are complemented by implementation steps and associated milestones to be undertaken by each operational stakeholder who is mandated by PCP to implement SWIM. In order to give a clear picture of the deployment, the milestones are explained below separately for the two groups. 1) **Milestones relevant for SWIM Governance project** The refinement of the structure of the SWIM Governance and the processes for performing governance developed during SESAR 1, in order to meet the needs of iSWIM deployment. This structure and the related processes shall subsequently be put in operation (**MM.1 – SWIM governance structure and processes set up**). Stakeholders shall be given the possibility to comment on the policies and processes put in place by the SWIM Governance (**MM.2 - Stakeholder consultation regarding SWIM Governance on policies and processes completed**). The concept of the design-time registry for SWIM devised during SESAR 1 shall be refined to meet the requirements of iSWIM deployment (**MM.3 – SWIM Registry refined (concept) and adopted by the SWIM Governance**). The SWIM Registry as a tool shall be developed and then tested **(MM.4 – SWIM Registry developed and adopted by the SWIM Governance)**. The SWIM Registry tool shall be deployed and made available for Operational Stakeholders to use (**MM.5 – SWIM Registry deployed and declared ready for use by the SWIM Governance**). 2) **Milestones relevant for implementing operational stakeholders** For full implementation of the Family the Stakeholder is expected to actively use the registry, i.e. to register his own services, use the registry to discover services, use the registry to retrieve SWIM standards and guidance material (**MM.6 – SWIM Registry used by concerned OS**). When implementing SWIM and its prerequisites each stakeholder has to take into account the requirements stemming from the safety and security assessment at functional level required by their respective NSA.

Family 5.1.4 – Common SWIM PKI and Cybersecurity

5.1.4 – Common SWIM PKI and cyber security			
Main Sub-AF	Sub-AF 5.1 Common Infrastructure Components		
Readiness for implementation	High		
Initial Operational Capability	01/06/2017	**Full Operational Capability**	01/01/2025

Description and Scope

Within the Commission Implementing Regulation (EU) No716/2014 the SWIM Infrastructure has been split in two parts:

- The common components § 5.1.1. Common infrastructure components.
- The stakeholders' components § 5.1.2. SWIM Technical Infrastructure and Profiles.

According to Commission Implementing Regulation (EU) No 716/2014 § 5.1.1. the **Common SWIM Infrastructure Components** are:

— ***The registry****, which shall be used for publication and discovery of information regarding service consumers and providers, the logical service and information models, SWIM enabled services (Service Implementations), business, technical, and policy information.*

— ***Public Key Infrastructure*** *(PKI), which shall be used for signing, emitting and maintaining certificates and revocation lists; The PKI ensures that information can be securely transferred.*

The Commission Implementing Regulation (EU) No 716/2014 stipulates also that *SWIM comprises standards, infrastructure and* ***governance*** *enabling the management of information and its exchange between operational stakeholders via interoperable services*.

The Public Key Infrastructure and cyber security are dealt with in two separate Families, Family 5.1.4 for the common part covering PKI governance and cyber security objectives, while Family 5.2.3 addresses the stakeholder implementation.

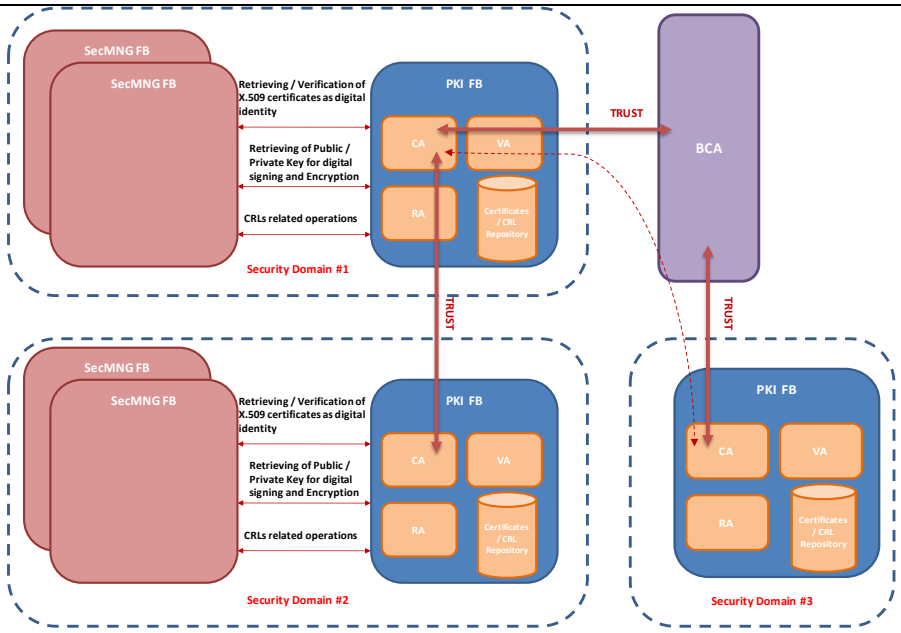
The scope of this Family is the implementation of the SWIM common components covering cyber security, common PKI and its governance. This Family addresses the overall European PKI and its governance, which the local implementations shall comply with.

The outcome of this Family shall support users from all civil and military stakeholders.

The technical implementation of PKI is a stakeholder issue and is covered by Family 5.2.3 while the common specifications relating to PKI and its governance are developed in this Family:

- Processes related to signing, emitting, maintaining and revoking certificates.
- Objectives and requirements for:
  - Confidentiality
  - Integrity
  - Non-repudiation
  - Accountability
  - Authenticity
  - Safety
- Rules and processes for delegating a certificate in order to meet national/local requirements.
- Establishment and tasks of bridge authorities (if used).
- Establishment and tasks of a root certification authority.

Global coordination to ensure secure information exchange on a world-wide scale.



FB: Functional Block
CA: Certificate Authority
VA: Validation Authority
RA: Registration Authority
CRL: Certificate Revocation Lists
BCA: Bridge Certificate Authority

Interdependencies

Please refer to the Short-Term Deployment Approach (see details in Section 3) for information regarding dependencies to other AF5 families.

Synchronization Needs

Strong coordination is necessary between all stakeholders to implement the common components.

Furthermore, an implementation project dealing with this Family needs strong coordination with the SWIM Governance Implementation project in order to comply with SWIM Governance policies and security requirements.

Civil / Military Coordination

It is recommended that data security and confidentiality is managed as an integrated requirement.

Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users, Network Manager, Military Authorities, MET Service Providers	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B1-SWIM Performance Improvement through the Application of System-Wide Information Management (SWIM)	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	IS-0901-A SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	INF08.1, INF08.2

Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.
Recommendations for IPs proposal	For the CEF 2017 call a group of stakeholders has proposed a common PKI and cybersecurity project, dealing with the topics of security and cyber security of SWIM. While the technical specification of PKI is mature, its application (organizational setup, processes etc.) in the ATM domain is not, hence the project will tackle the completion of this topic to ensure its implementation by all stakeholders within the FOC date stipulated by the Commission Implementing Regulation (EU) No 716/2014.
Family Deployment Approach	5.1.4 is similar to 5.1.3 as the outcome of the project is to lay the groundwork for a common European SWIM PKI and its governance for the sake of all stakeholders. The task also includes coordination with FAA in order to ensure global interoperability. The project will prepare the deployment of European SWIM PKI and the matching governance Once these tasks are finished, the project will close and the European SWIM PKI and its governance shall be operated in regular mode by all stakeholders. A number of implementation steps and associated milestones have to be undertaken solely for the common European PKI; these are complemented by implementation steps and associated milestones to be undertaken by each operational stakeholder who is mandated by PCP to implement SWIM. In order to give a clear picture of the deployment, the milestones are explained below separately for the two groups. **1) Milestones relevant for the common PKI and its governance** The implementation of this Family at first requires the setup of the PKI governance policies and processes **(MM.1 - PKI governance processes set up)**. Stakeholders shall be given the possibility to comment on the policies and processes put in place for the PKI Governance, in particular the security policy and minimum-security objectives. Secondly coordination with FAA is needed to ensure global interoperability **(MM.2 - Stakeholder consultation regarding PKI Governance principles completed)**. Based on the consultation, the PKI Governance can ensure and steer the implementation of the common PKI. **(MM.3 - PKI deployed and declared ready for use)**. **2) Milestones relevant for implementing operational stakeholders** The Family implementation is finished once the PKI concept is used operationally by the stakeholders **(MM.4 - PKI used by concerned OS)**. When implementing SWIM each stakeholder has to take into account the requirements stemming from the safety and security assessment at functional level required by their respective NSA.

Family 5.2.1 – Stakeholders Internet Protocol Compliance

5.2.1 – Stakeholders Internet Protocol Compliance			
Main Sub-AF	Sub-AF 5.2 SWIM Infrastructure and Profiles		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2018

Description and Scope
The Commission Implementing Regulation (EU) No 716/2014 stipulates *"Initial System Wide Information Management (iSWIM) supports information exchanges that are built on standards and delivered through an internet protocol (IP)-based network by SWIM enabled systems"*. So, the availability of an IP-compliant network capable of supporting the Yellow and Blue SWIM Profiles is a prerequisite for iSWIM deployment. This Family deals with implementing an Internet Protocol-compliant network for each civil and military stakeholder to be able to support future information exchanges through SWIM Yellow and Blue profiles. The final specification of the Blue Profile is foreseen to be published in 2021, i.e. after the FOC date of this Family. Thus, the implementation of this Family can only be based on the information of the Blue Profile available during project implementation. Updates and changes to the IP network stemming from the exact requirements of the Blue Profile after the publication of the specification will be accommodated in Family 5.2.2.
Interdependencies
Please refer to the Short-Term Deployment Approach (see details in Section 3) for information regarding dependencies to other AF5 families.
Synchronization Needs
Each civil and military stakeholder not yet Internet Protocol compliant should plan to transition to Internet Protocol, preferably version 6, connectivity in order to be in a position to exchange information with other stakeholders in the near future through SWIM Network with the adequate SWIM Profiles.
Civil / Military Coordination
There are clear benefits for all stakeholders to coordinate and synchronize the deployment of SWIM infrastructure in order to exploit the efficient sharing of information between civil and military stakeholders. Therefore, all stakeholders planning migration to IP connectivity are encouraged to coordinate between civil and military authorities.

Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users, Network Manager, Military Authorities, MET Service Providers	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B1-SWIM Performance Improvement through the Application of System-Wide Information Management (SWIM)	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	CTE-C06 Available
	ATM Master Plan Level 3 (Edition 2019)	COM12, INF08.1, INF08.2

Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.
Recommendations for IPs proposal	Stakeholders not yet compliant are highly invited to present implementation projects for achieving IP compliance. It is recommended to take into consideration the results of the Gap Analysis provided within the Monitoring View.
Family Deployment Approach	The implementation of the Family would require the deployment of the Internet Protocol Services in order to ensure the handling of the Yellow Profile. References: SESAR 14.01.04.D43-004-SWIM-TI Yellow Profile Technical Specification 3.1, 14.01.04.D43-005-SWIM-TI Blue Profile Technical Specification 3.1, 14.01.04.D43-SWIM Profiles Interface Bindings Catalogue (**MM1 – Internet Protocol based Network supporting Yellow Profile**). The Internet Protocol Services shall then be deployed in order to support the Blue Profile. References: SESAR 14.01.04.D43-004-SWIM-TI Yellow Profile Technical Specification 3.1, 14.01.04.D43-005-SWIM-TI Blue Profile Technical Specification 3.1, 14.01.04.D43-SWIM Profiles Interface Bindings Catalogue (**MM2 – Internet Protocol based Network supporting Blue Profile**). When implementing SWIM each stakeholder has to take into account the requirements stemming from the safety and security assessment at functional level required by their respective NSA.

Family 5.2.2 – Stakeholders SWIM Yellow and Blue Profiles Infrastructures Components

<table>
<tr><th colspan="5">5.2.2 – Stakeholders SWIM Yellow and Blue Profiles Infrastructures Components</th></tr>
<tr><td>Main Sub-AF</td><td colspan="4">Sub-AF 5.2 SWIM Infrastructure and Profiles</td></tr>
<tr><td rowspan="2">Readiness for implementation</td><td>Yellow Profile</td><td colspan="3">High regardless of link to actual information exchange implementation</td></tr>
<tr><td>Blue Profile</td><td colspan="3">Medium regardless of link to actual information exchange implementation</td></tr>
<tr><td rowspan="2">Initial Operational Capability</td><td>Yellow Profile</td><td>Before 2014
Even if the common SWIM Infrastructure is not yet formally set-up, some Stakeholders have already started the implementation of SWIM by using the first deliverables of SESAR1</td><td rowspan="2">Full Operational Capability</td><td rowspan="2">01/01/2025</td></tr>
<tr><td>Blue Profile</td><td>01/01/2021</td></tr>
<tr><th colspan="5">Description and Scope</th></tr>
<tr><td colspan="3">Yellow Profile</td><td colspan="2">Blue Profile</td></tr>
<tr><td colspan="3">Within the Commission Implementing Regulation (EU) No 716/2014 the SWIM Infrastructure has been split in two parts:
- The common components § 5.1.1. Common infrastructure components.
- The stakeholders' components § 5.1.2. SWIM Technical Infrastructure and Profiles.
According to §5.1.2. SWIM Technical Infrastructure and Profiles of the above-mentioned regulation implementation shall be driven by the following requirements:
Implementation of yellow profile shall be based on standards and interoperable products and services. Yellow SWIM TI Profile shall be used for exchange of ATM data (aeronautical, meteorological, airport, etc.).
Yellow TI profile is applicable to all information exchange services defined in Families 5.3.1, 5.4.1, 5.5.1 and 5.6.1.
This Family deals with the Stakeholders Yellow Profile Infrastructure Components while Family 5.1.3 Common SWIM Infrastructure Components is dealing with the common SWIM components, e.g. the governance of SWIM.
Families 5.1.4 Common PKI and cyber security and 5.2.3 stakeholders PKI and cyber security respectively cover common and local Cyber security implementation.
Overall, this Family aims at the implementation of the following SWIM components at each Operational Stakeholder:
- Yellow Profile</td><td colspan="2">Within the Commission Implementing Regulation (EU) No 716/2014 the SWIM Infrastructure has been split in two parts:
- The common components § 5.1.1. Common infrastructure components.
- The stakeholders' components § 5.1.2. SWIM Technical Infrastructure and Profiles.
According to §5.1.2. SWIM Technical Infrastructure and Profiles of the above-mentioned regulation implementation shall be driven by the following requirements:
Implementation of Blue Profile shall be based on standards and interoperable products and services. This Family covers Blue Profile, which shall be used for exchanging flight information between ATC centres and between ATC and Network Manager.
Blue profile is intended for Flight Object exchange services as defined in Family 5.6.2.
This Family deals with the Stakeholders Blue Profile Infrastructure Components while Family 5.1.3 Common SWIM Infrastructure Components is dealing with the common SWIM components, e.g. the governance of SWIM.
Families 5.1.4 Common PKI and cyber security and 5.2.3 stakeholders PKI and cyber security respectively cover common and local Cyber security implementation.
Overall, this Family aims at the implementation of the following SWIM components at each Operational Stakeholder:
- Blue Profile</td></tr>
</table>

- Training and certification of technical personnel - All other components necessary for stakeholder SWIM implementation (supervision, monitoring and control) This Family also addresses the stakeholder transition issues from legacy protocols (AFTN, AMHS, FMTP,) to the SWIM environment. Note that the definition of the Yellow Profile does not target contexts, in which - real-time or near real-time use or - extreme high availability are required. These restrictions mainly apply if Yellow Profile is deployed using public internet as the transport medium, which cannot guarantee an appropriate QoS level. For this reason, it is recommended to assess the QoS requirements of the SWIM services vis-à-vis the QoS level available by the public internet and to use a network service with guaranteed QoS**,** for example PENS1/NewPENS, as underlying transport medium if the required QoS level is not achievable by public internet.	- Training and certification of technical personnel - All other components necessary for stakeholder SWIM implementation (supervision, monitoring and control) This Family also addresses the Stakeholder transition issues from legacy protocols (AFTN, AMHS, FMTP, OLDI) to Blue Profile. The specification of the Blue Profile is foreseen to be published in 2021. The exact requirements for the underlying IP network are not comprehensively known before the publication. For this reason, Family 5.2.2 also includes potential upgrades to the IP network that might be required in order to implement the Blue Profile.

Interdependencies
Please refer to the Short-Term Deployment Approach (see details in Section 3) for information regarding dependencies to other AF5 families.
Synchronization Needs
Strong coordination and synchronisation are necessary between all stakeholders (including military) to implement their SWIM infrastructure.
Civil / Military Coordination
Yes, civil/military coordination is required

Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users, Network Manager, Military Authorities, MET Service Providers			
Other stakeholders involved in the Family deployment	None			
Links to ICAO GANP ASBUs	B1-SWIM Performance Improvement through the Application of System-Wide Information Management (SWIM)			
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	**Yellow Profile**	IS-0901-A SESAR Release 5	
		Blue Profile	IS-0901-A SESAR Release 5	CM-0201-A SESAR 2020
	ATM Master Plan Level 3 (Edition 2019)	**Yellow Profile**	INF08.1	
		Blue Profile	INF08.2	
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.			

Recommendations for IPs proposal	According to their SWIM implementation planning, stakeholders are invited to propose IPs to implement their SWIM infrastructure as basis for the implementation of ATM information exchanges according to the PCP (aeronautical, meteorological, cooperative network and flight information exchange). Due to the fundamental nature of Family 5.2.2 for the implementation of AF5 and the rather tight schedule for implementing it on time, SDM recommends prioritizing the implementation of this Family in order to ensure the PCP implementation is achieved in due time.
Family Deployment Approach[24]	The implementation of the Family requires the definition of the future system architecture able to cover information exchanges in compliance with SWIM Governance policies and Yellow profile standards. Furthermore, technical monitoring and control shall be supported as well. The architecture concept shall also include SWIM-enabled applications defined in AF1, AF2, AF3 and AF4. (**MM1 – Architecture concept for SWIM infrastructure available**) The SWIM TI Yellow Profile middleware shall be implemented; supporting technical monitoring and control shall be in place and operational; all relevant technical personnel shall be duly trained (for ANSPs this means the issuance of new S/E ratings to ATSEPs according to Commission Implementing Regulation 2017/373) (**MM3 – Installation of local Infrastructure Components to support SWIM communication**). Before the start of operational use, the local infrastructure shall be both verified and validated, ready to support communication between SWIM-enabled applications. The local infrastructure must be compliant to the relevant SWIM Governance policies to guarantee interoperability within the SWIM network. The execution of such activities will lead to the start of permanent operational use (**MM4 – Implementation completed**). When implementing SWIM, each stakeholder has to take into account the requirements stemming from the safety and security assessment at functional level required by their respective NSA.

[24] For further information concerning the mean duration of the Family implementation, please refer to the Short-Term Deployment Approach, as reported within Chapter 3.

Family 5.2.3 – Stakeholders SWIM PKI and Cybersecurity

5.2.3 – Stakeholders' SWIM PKI and cyber security			
Main Sub-AF	Sub-AF 5.2 SWIM Infrastructure and Profiles		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2025

Description and Scope

This Family is dealing with the **Stakeholders' SWIM PKI and cyber security** while Family 5.1.4 covers governance and cyber security objectives. This Family aims at implementing basic/generic public key infrastructure management at each civil or military stakeholder, in line with their own Security Management System approved by their National Supervisory Authority. The local implementation may differ depending on whatever the stakeholder will become a CA themselves or use a common or external CA. This PKI management includes:

- Certificate emitting
- Certificate signing
- Certificate distribution
- Certificate renewal
- Certificate revocation
- Certificate suspension
- Certificate verification
- Certificate storing

Key lifecycle Management includes:

- Creation of key pairs
- Updating keys
- Archiving keys
- Backup and recovery
  - Training and certification of technical personnel;
  - monitoring and control, in particular, establish a Security Operations Center to monitor and protect the IT systems against cyber-attacks;
  - procedure development covering normal and degraded operation. Technical standard operating procedures (SOPS) shall also cover certificate management;
  - local policies for authorising and mandating local organization to do certificate management;
  - definition of policies and procedures ensuring compliant certificate usage with respect to both common (AF 5.1.4) and local standards;
  - implementation of audit programmes ensuring continuous compliance with common and local policies and standards.

Interdependencies

Please refer to the Short-Term Deployment Approach (see details in Section 3) for information regarding dependencies to other AF5 families.

Synchronization Needs

It is essential that appropriate SWIM Governance Structure and Processes are established to develop and monitor an agreed SWIM implementation roadmap.

Civil / Military Coordination

Yes, civil/military coordination is required

Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users, Network Manager, Military Authorities, MET Service Providers	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B1-SWIM Performance Improvement through the Application of System-Wide Information Management (SWIM)	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	IS-0901-A SESAR Release 5 CM-0201-A SESAR 2020
	ATM Master Plan Level 3 (Edition 2019)	INF08.1, INF08.2
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Stakeholders are invited to launch projects implementing local PKI and cyber security measures in line with requirements from SWIM Governance. Though changes to the use of PKI in the SWIM context are expected, PKI is very mature both regarding technology and management. The advantages of early implementation of PKI outweigh later changes to SWIM standards.	
Family Deployment Approach	The implementation of the Family requires the definition of the future system architecture able to cover security for the information exchanges in compliance with SWIM Governance policies. The concept shall also take into account SWIM-enabled applications defined in AF1, AF2, AF3 and AF4 **(MM1 – Cyber security and PKI architecture concept available)**. The SWIM information exchange implementation plan shall be defined or enhanced in order to cover the cyber security requirements for all information exchanges. The implementation plan shall in detail describe the realization of PKI defined in the previous milestone and it must be compliant with the relevant SWIM Governance policies. Furthermore, the plan shall specifically address the introduction of PKI, ensuring flight safety and minimizing negative network effects (Part of Safety Case) and it may be linked to concrete implementation of the communication between SWIM-compliant applications **(MM2 – PKI implementation plan available)**. The PKI and further cyber security measures defined within the Yellow or Blue SWIM TI profile shall be implemented; all relevant technical personnel shall be duly trained **(MM3 – Installation of local Infrastructure Components to support Yellow/Blue profile communications)**. Before the start of operational use, the local cyber security infrastructure shall be both verified and validated, ready to support communication between SWIM-enabled applications. The local cyber security infrastructure must be compliant to the relevant SWIM Governance policies to guarantee interoperability. The execution of these activities will lead to the start of permanent operational use **(MM4 – Implementation completed)**. When implementing SWIM each stakeholder has to take into account the requirements stemming from the safety and cyber security assessment at functional level required by their respective NSA and particularly the NSA-approved cyber security management system.	

Family 5.3.1 – Upgrade / Implement Aeronautical Information Exchange system / service

5.3.1 – Upgrade / Implement Aeronautical Information Exchange system / service			
Main Sub-AF	Sub-AF 5.3 SWIM Aeronautical Information Exchange		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2025

Description and Scope

Commission Implementing Regulation (EU) No 716/2014 stipulates the following with regard to Aeronautical Information exchange: *Operational stakeholders shall implement services which support the exchange of the following aeronautical information using the yellow SWIM TI Profile:*

- *Notification of the activation of an Airspace Reservation/Restriction (ARES)*
- *Notification of the de-activation of an Airspace Reservation/Restriction (ARES)*
- *Pre-notification of the activation of an Airspace Reservation/Restriction (ARES)*
- *Notification of the release of an Airspace Reservation/Restriction (ARES)*
- *Aeronautical information feature on request. Filtering possible by feature type, name and an advanced filter with spatial, temporal and logical operators.*
- *Query Airspace Reservation/Restriction (ARES) information*
- *Provide Aerodrome mapping data and Airport Maps* (including eTOD: electronic Terrain and Obstacle Data)
- *Airspace Usage Plans (AUP, UUP) — ASM level 1, 2 and 3*
- *D-NOTAMs*

Service implementations shall be compliant with the applicable version of Aeronautical Information Reference Model (AIRM), the AIRM Foundation Material and the Information Service Reference Model (ISRM) Foundation Material.

This Family aims at upgrading or implementing Aeronautical Information Exchange systems and services in accordance with SWIM principles.

The systems shall be upgraded or implemented to support the Aeronautical Information exchange as service provider or service consumer; the service implementation shall comply with the Yellow SWIM TI Profile, either using the Public Internet or PENS1/NewPENS. The service implementations shall further be compliant with the applicable version of the standardisation material which corresponds to the material mentioned in the Implementing Rule (AIRM, the AIRM Foundation Material and the ISRM Foundation Material), in particular with the SWIM Policies and the Eurocontrol SWIM Specifications. The applicable version of these documents will at any time be available in the SWIM registry, which is maintained by the SWIM Governance.

Appendix 1 contains a list of services that provide partial coverage of the Commission Implementing Regulation (EU) No 716/2014 based on services developed in the context of SESAR 1 or services deployed or planned by NM.

Once established, the SWIM Governance will be responsible for the maintenance and publication of this list to finally cover the whole PCP scope; the actual list of services will be available at any time in the registry managed by the SWIM Governance. The registry will also contain the detailed specifications of the services (Service descriptions compliant with the published Eurocontrol specification) and the technical specifications related to the implementation (TI Profile specification etc.), allowing the consumers to develop applications that use these services. The stakeholder systems shall be adapted to initially support the legacy information exchanges (e.g. AFTN, AMHS …) and the SWIM Yellow profile information exchanges simultaneously, allowing a smooth migration of the stakeholders to SWIM. Security and availability shall be upgraded to support the strong dependencies caused by the system to system interactions. Stakeholder security shall be improved by conducting a security risk assessment and by establishing security monitoring and management tools and procedures. The related ATM systems requiring aeronautical information shall be able to use the Aeronautical information exchange services.

Interdependencies
Please refer to the Short-Term Deployment Approach (see details in Section 3) for information regarding dependencies to other AF5 families.
Synchronization Needs
For services provided by the European Aeronautical Database (EAD) synchronization will be needed between IPs intending to exchange data with the EAD and the providers of EAD to ensure that the required functionality is available at the right point in time. For services provided by the Network Manager, synchronization for the data exchanges will be needed between the partners of the Implementing Projects and the NM.
Civil / Military Coordination
ARES information sharing needs coordination

Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users, Network Manager, Military Authorities	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B1-DATM Service Improvement through Integration of all Digital ATM Information	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	IS-0901-A SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	INF08.1
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Stakeholders are invited to deploy the services using Appendix 1 as a starting point. For Services previously deployed, the Stakeholders have to upgrade, if necessary, according to the SWIM Governance material.	
Family Deployment Approach	The implementation of this Family requires an analysis of upgrades and new implementations of services to be performed, as well as the development of a concept on how to tackle the transition for this Family. This analysis shall include the development of a roadmap of the transition and the identification of the relevant artefacts (Roadmap, services definition, AIRM version, XM models, Profiles, Safety and Security framework, compliance framework) (**MM1 – Transition concept from legacy protocol (AFTN…) to SWIM**). While the transition concept is expected to be produced once for all concerned services, the individual services may have different implementation roadmaps. Thus, they can reach the milestones at different points in time. Before the start of operational use, the service interfaces to either provide or consume the Family 5.3.1 services shall be developed and integrated with the systems providing or consuming the data exchanged by these services (**MM2 – New implementation or upgrade of Service Interface and system integration developed**).	

	The service interfaces and the integration with the data-providing or –consuming systems shall then be validated (**MM3 – New implementation or upgrade of Service Interface and system integration validated**). The deployment of the new or upgraded services shall be planned, in terms of operation with other Stakeholders who are providers or consumers of the services: NM, ANSPs, AUs, Airport Operators, etc. (**MM4 – Planning of communications deployment**). The execution of these activities will lead to the start of permanent operational use for the Operational Stakeholders (**MM5 – Implementation completed**). When implementing SWIM each stakeholder has to take into account the requirements stemming from the safety and security assessment at functional level required by its respective NSA.

Family 5.4.1 – Upgrade / Implement Meteorological Information Exchange system / service

5.4.1 – Upgrade / Implement Meteorological Information Exchange system / service			
Main Sub-AF	Sub-AF 5.4 SWIM Meteorological Information Exchange		
Readiness for implementation	High		
Initial Operational Capability	01/01/2016	**Full Operational Capability**	01/01/2025

Description and Scope

Commission Implementing Regulation (EU) No 716/2014 stipulates the following with regard to Meteorological Information exchange: *Operational stakeholders shall implement services which support the exchange of the following meteorological information using the yellow SWIM TI Profile:*

- *Meteorological prediction of the weather at the airport concerned, at a small interval in the future:*
  - *wind speed and direction*
  - *the air temperature*
  - *the altimeter pressure setting*
  - *the runway visual range (RVR)*
- *Provide Volcanic Ash Mass Concentration*
- *Specific MET info feature service*
- *Winds aloft information service*
- *Meteorological information supporting Aerodrome ATC & Airport Landside process or aids involving the relevant MET information, translation processes to derive constraints for weather and converting this information in an ATM impact; the system capability mainly targets a 'time to decision' horizon between 20 minutes and 7 days.*
- *Meteorological information supporting En Route/Approach ATC process or aids involving the relevant MET information, translation processes to derive constraints for weather and converting this information in an ATM impact; the system capability mainly targets a 'time to decision' horizon between 20 minutes and 7 days*
- *Meteorological information supporting Network Information Management process or aids involving the relevant MET information, translation processes to derive constraints for weather and converting this information in an ATM impact* (by making use of probabilistic models to aid decision support*); the system capability mainly targets a 'time to decision' horizon between 20 minutes and 7 days*

This Family aims at upgrading or implementing Meteorological Information Exchange systems and services in accordance with SWIM principles. All Meteorological Information required for the implementation of the Families in AF1, AF3 and AF4[25] has to be provided by services situated in Family 5.4.1; in this sense Family 5.4.1 constitutes the gateway between the meteorological and the ATM world.

The systems shall be upgraded or implemented to support the exchange of Meteorological Information as service provider or service consumer in IWXXM, GRIB2, netCDF or HDF5 data formats; the service implementation shall comply with the Yellow SWIM TI Profile, either using the Public Internet or PENS1/NewPENS as the transport network. The different communications paradigms of this profile shall be adapted for supporting the different levels of technical compliance of the stakeholders.

The service implementations shall further be compliant with the applicable version of the standardisation material which corresponds to the material mentioned in the Implementing Rule (AIRM, the AIRM Foundation Material and the ISRM Foundation Material), in particular with the SWIM Policies and the

[25] The implementation of AF2 will also require meteorological information, however the use of SWIM for retrieving meteorological information is not mandated for AF2 by the PCP IR

Eurocontrol SWIM Specifications. The applicable version of these documents will at any time be available in the SWIM registry, which is maintained by the SWIM Governance.

Appendix 1 contains a list of services that provide partial coverage of the Commission Implementing Regulation (EU) No 716/2014 based on services developed in the context of SESAR 1 or services deployed or planned by NM.

Once established, the SWIM Governance will be responsible for the maintenance and publication of this list to finally cover the whole PCP scope; the actual list of services will be available at any time in the registry managed by the SWIM Governance.

The registry will also contain the detailed specifications of the services (Service descriptions compliant with the published Eurocontrol specification) and the technical specifications related to the implementation (TI Profile specification etc.), allowing the consumers to develop applications that use those services.

The stakeholder systems shall be adapted to initially support the legacy information exchanges and the SWIM Yellow profile information exchanges, allowing a smooth migration of the stakeholders to SWIM. Security and availability shall be upgraded to support the strong dependencies caused by the system to system interactions.

Stakeholder security shall be improved by conducting a security risk assessment and by establishing security monitoring and management tools and procedures. The related ATM systems requiring meteorological information shall be able to use the Meteorological information exchange services.

Interdependencies

Interdependency with Family 5.1.3 since SWIM Governance processes and bodies will be used to propose a list of services required to fulfil the Commission Implementing Regulation (EU) No 716/2014.

The completion of the deployment of the Families 5.1.3, 5.1.4, 5.2.1, 5.2.2 and 5.2.3 for implementing the physical interconnection and the common and stakeholder-specific infrastructure components is required for the full implementation of Family 5.4.1. For Operational Stakeholders (almost all the ANSPs) having decided to use PENS for the Yellow Profile the deployment of 5.1.1/5.1.2 is also required.

Interdependencies with Families 2.1.4 – Initial Airport Operations Plan (AOP), 2.3.1 – Time Based Separation and 4.2.4 - AOP/NOP information Sharing regarding meteorological information and systems.

Further interdependencies with all Families requiring meteorological information for their full implementation, including but not limited to Families 1.1.1, 1.1.2, 3.1.4, 4.1.1, 4.1.2, 4.2.2 and 4.4.2.

Synchronization Needs

Please refer to the Short-Term Deployment Approach (see details in Section 3) for information regarding dependencies to other AF5 families.

Civil / Military Coordination

Yes, civil/military coordination is required

Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users, Network Manager, Military Authorities, MET Service Providers	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B1-AMET Enhanced Operational Decisions through Integrated Meteorological Information (Planning and Near-term Service)	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	IS-0901-A SESAR Release 5 MET-0101 SESAR Release 5

	ATM Master Plan Level 3 (Edition 2019)	INF08.1
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Stakeholders are invited to deploy the services using Appendix 1 as a starting point. For Services previously deployed, the Stakeholders have to upgrade, if necessary, according to the SWIM Governance material.	
Family Deployment Approach	The implementation of this Family requires an analysis of upgrades and new implementations of services to be performed, as well as the development of a concept on how to tackle the transition for this Family. This analysis shall include the development of a roadmap of the transition and the identification of the relevant artefacts (Roadmap, services definition, AIRM version, XM models, Profiles, Safety and Security framework, compliance framework) (**MM1 – Transition concept from legacy protocol (AFTN…) to SWIM**). While the transition concept is expected to be produced once for all concerned services, the individual services may have different implementation roadmaps. Thus, they can reach the milestones at different points in time. Before the start of operational use, the service interfaces to either provide or consume the Family 5.4.1 services shall be developed and integrated with the systems providing or consuming the data exchanged by these services. (**MM2 – New implementation or upgrade of Service developed**). The service interfaces and the integration with the data-providing or –consuming systems shall then be validated. (**MM3 – New implementation or upgrade of Service validated**). The deployment of the new or upgraded services shall be planned in terms of operation with other Stakeholders who are providers or consumers of the services: NM, ANSPs, AUs, Airport Operators, etc. (**MM4 – Planning of communications deployment**). The execution of these activities will lead to the start of permanent operational use for the Operational Stakeholders (**MM5 – Implementation completed**). When implementing SWIM, each stakeholder has to take into account the requirements stemming from the safety and security assessment at functional level required by its respective NSA.	

Family 5.5.1 – Upgrade / Implement Cooperative Network Information Exchange system/service

5.5.1 – Upgrade / Implement Cooperative Network Information Exchange system / service			
Main Sub-AF	Sub-AF 5.5 Cooperative Network Information Exchange		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2025 The Network Operation Plan plans a completion of this Family by end of 2019 as the Cooperative Network Information exchanges are based on mature technologies and services.

Description and Scope

The Network Information will be freely exchanged between the systems of the operational stakeholders by means of defined cooperative network information B2B services, using the Yellow SWIM TI Profile. The scope of the Family is the implementation by the operational stakeholders of the cooperative network information exchange with NM using the Yellow SWIM TI Profile for the sake of Air Traffic Flow and Capacity Management.

The information to be exchanged according to the PCP comprises:

- Maximum airport capacity based on current and near-term weather conditions,
- Synchronization of Network Operations Plan and all Airport Operations Plans,
- Departure and arrival planning information,
- ATFCM pre-tactical and tactical plans (regulations, re-routings, sector configurations, runway updates, monitoring values, capacities, traffic volume activations, scenarios, etc.),
- Short term ATFCM measures,
- ATFCM congestion points,
- Network events,
- Rerouting opportunities,
- Restrictions,
- Traffic counts information,
- Demand data (civil, military),
- Flow and Flight message exchange (flight exchanges are meant for ATFCM purpose),
- Airspace structure, availability and utilisation,
- Network and En-Route/Approach Operation Plans,
- Network impact assessment,
- Service availability information,
- General information messages (ATFCM Information Messages and headline news),

The systems shall be upgraded to support the exchange of information in compliance with the Yellow SWIM TI Profile, either through the Public Internet and/or PENS. The choice of communication service depends on a business criticality assessment from where minimum performance requirements are identified. The different communications paradigms of this profile shall be provided by the Network Manager, supporting the different levels of technical compliance of the stakeholders.

The list of SWIM services developed by NM and already available in operations that are in scope of 5.5.1 is the following:

- Airspace structure, availability and utilisation:
  - Download of complete AIXM 5.1 datasets with the following entities: AS, PT, RT, UT, AD, AZ, TV, TZ, RL, FW, RS.
  - Incremental AIXM 5.1 datasets.
  - Creation and update of Airspace Use Plan service for AMCs.
  - Publication of the European Airspace Use Plan.

- ATFCM pre-tactical and tactical plans
  - Retrieve regulation list and details, sector configuration plans, runways configuration plan, monitoring values, capacity plan, traffic volume activations.
  - Create and update sector configurations plan, runways configuration plan, monitoring values, capacity plan, traffic volume activations.
- Restrictions
  - Part of the airspace structure service.
- Traffic counts information
  - Traffic counts (entry or occupancy, where relevant) by AO, by AD, by AZ, by AS, by PT, by TV
- General Information Messages
  - Retrieve ATFCM Information messages.
- Flow and Flight message exchange (flight exchanges are meant for ATFCM purposes)
  - Retrieve flight lists by keys, AO, AD, PT, AS, TV, AZ, measure, hotspot, registration mark.
  - Retrieve flight details.

The service implementations shall be compliant with the applicable version of the standardisation material which corresponds to the material mentioned in the Implementing Rule (AIRM, the AIRM Foundation Material and the ISRM Foundation Material), in particular with the SWIM Policies and the Eurocontrol SWIM Specifications. The applicable version of these documents will at any time be available in the SWIM registry, which is maintained by the SWIM Governance.

Appendix 1 provides a mapping between the PCP required information exchanges and the NM B2B services already operational (see above) or planned that support those exchanges. The Network Manager systems shall be adapted to initially support the legacy information exchanges and the yellow SWIM profile information exchange simultaneously, allowing for a progressive migration of the stakeholders to SWIM. The exchange of data with NM via an HMI is covered in Family 4.2.2. Security and availability shall be upgraded to support the strong dependencies caused by the system to system interactions.

Interdependencies

Please refer to the Short-Term Deployment Approach (see details in Section 3) for information regarding dependencies to other AF5 families.

Synchronization Needs

NM shall coordinate and support the stakeholders for the deployment of the information exchange with NM via the NM B2B services.

Civil / Military Coordination

Yes, civil/military coordination is required

Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users, Network Manager, Military Authorities	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B1-FICE Increased Interoperability, Efficiency and Capacity through Flight and Flow Information for a Collaborative Environment Step-1 (FF-ICE/1) application before Departure B1-NOPS Enhanced Flow Performance through Network Operational Planning	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	IS-0901-A SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	INF08.1

Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.
Recommendations for IPs proposal	This is a multi-stakeholder initiative (NM and various Network users), thus stakeholders' initiatives should be synchronized to foster benefits. NM shall coordinate and support the stakeholders for the deployments of the NM services but it is not recommended to package deployments in a unique project.
Family Deployment Approach	The priority of each service implementation is dictated by the other AFs identified in the "Interdependencies" section. For each service the following implementation milestones, involving NM and the stakeholders, were identified: - Development of a concept and plan for how to migrate from current situation with legacy protocols to SWIM service implementation. Such analysis shall include the development of a roadmap of the transition and the identification of the relevant artefacts, including aspects of safety and security and compliance. The transition plan involves the impacted stakeholders via the Network Manager governance bodies **(MM1 – Transition concept from legacy protocol (AFTN…) to SWIM)**. - Specifications for each service shall be provided by the Network Manager allowing the stakeholders to start their development. This includes specification of performance requirements for the communication service **(MM2 – Specification from NM available)** - The service interfaces to either provide or consume the Family 5.5.1 services shall be developed and integrated with the systems providing or consuming the data exchanged by these services **(MM3 – New implementation or upgrade of Service developed**. The service interfaces and the integration with the data-providing or –consuming systems shall then be validated **(MM4 – New implementation or upgrade of Service validated)** - Deployment plan shall be communicated and executed by NM **(MM5 – Planning of NM Communications deployment)** and by the stakeholders **(MM6 – Planning of communications deployment with NM completed)** - Start of permanent operational use of the service by the stakeholders **(MM7 – Implementation completed)**. When implementing SWIM, each stakeholder has to take into account the requirements stemming from the safety and security assessment at functional level required by its respective NSA.

Family 5.6.1 – Upgrade / Implement Flights Information Exchange system / service supported by Yellow Profile

5.6.1 – Upgrade / Implement Flights Information Exchange system / service supported by Yellow Profile			
Main Sub-AF	Sub-AF 5.6 SWIM Flights Information Exchange		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	01/01/2025

Description and Scope

Commission Implementing Regulation (EU) No 716/2014 stipulates the following with regard to Flight Information exchange: *[...] Operational stakeholders shall implement the following services for exchange of flight information using the yellow SWIM TI Profile:*

- Validate flight plan and routes

- Flight plans, 4D trajectory, flight performance data, flight status

- Flights lists and detailed flight data

- Flight update message related (departure information)

Service implementations shall be compliant with the applicable version of AIRM, the AIRM Foundation Material and the ISRM Foundation Material.

This Family aims at upgrading or implementing Flight Information Exchange systems and services supported by the Yellow Profile in accordance with SWIM principles.

The systems shall be upgraded or implemented to support the Flight Information exchange as service provider or service consumer; the service implementation shall comply with the Yellow SWIM TI Profile, either using Public Internet or PENS1/NewPENS as the transport network.

The service implementations shall further be compliant with the applicable version of the standardisation material which corresponds to the material mentioned in the Implementing Rule (AIRM, the AIRM Foundation Material and the ISRM Foundation Material), in particular with the SWIM Policies and the Eurocontrol SWIM Specifications. The applicable version of these documents will at any time be available in the SWIM registry, which is managed by the SWIM Governance.

This Family provides the prerequisites for trajectory management, which in addition to the Flight Object (Family 5.6.2) requires the sharing of information regarding

- Aircraft performance,
- Trajectory, and
- Meteorological data.

While the last type of information is covered by Family 5.4.1, the other 2 information categories are considered part of this Family dealing with, among other topics, as stated in the PCP, "*4D trajectory, flight performance data*".

Appendix 1 contains a list of services that provide partial coverage of the Commission Implementing Regulation (EU) No 716/2014 based on services developed in the context of SESAR 1 or services deployed or planned by NM. Once established, the SWIM Governance will be responsible for the maintenance and publication of this list to finally cover the full PCP scope; the up to date list of services will be available at any time in the registry managed by the SWIM Governance.

The registry will also contain the detailed specifications of the services (Service descriptions compliant with the published Eurocontrol specification) and the technical specifications related to the implementation (TI Profile specification, etc.), allowing consumers to develop applications using these services.

The stakeholder systems shall be adapted to initially support the legacy information exchanges (e.g. AFTN, AMHS …) and the SWIM Yellow profile information exchanges simultaneously, allowing a smooth migration of the stakeholders to SWIM. Security and availability shall be upgraded to support the strong dependencies caused by the system to system interactions.

Stakeholder security shall be improved by conducting a security risk assessment and by establishing security monitoring and management tools and procedures. The related ATM systems requiring Flight information shall be able to use the Flight information exchange services.
Interdependencies
Please refer to the Short-Term Deployment Approach (see details in Section 3) for information regarding dependencies to other AF5 families.
Synchronization Needs
The coordination could be performed by NM for the information exchanges performed with NM.
Civil / Military Coordination
Particular needs of the military must be considered, when justified by civil-military interoperability. Where for operational security reasons there are restrictions to share the information specific mitigating measures must be introduced including higher level security measures or alternative exchange mechanisms.

Stakeholders considered as gaps	ANSPs, Airport Operators, Airspace Users, Network Manager, Military Authorities	
Other stakeholders involved in the Family deployment	None	
Links to ICAO GANP ASBUs	B1-FICE Increased Interoperability, Efficiency and Capacity through Flight and Flow Information for a Collaborative Environment Step-1 (FF-ICE/1) application before Departure B2-FICE Improved Coordination through Multi-centre Ground-Ground Integration (FF ICE, Step 1 and Flight Object, SWIM)	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	IS-0901-A SESAR Release 5
	ATM Master Plan Level 3 (Edition 2019)	INF08.1
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Stakeholders are expected to submit IPs for the exchange of flight information via the SWIM Yellow Profile, either proposals that include the use of the NM B2B Flight Services or proposals for the provision of services in this domain. As stated above there are several information exchanges required as prerequisite for trajectory management. SDM explicitly encourages projects dealing with these information exchanges in preparation for the deployment of the families related to trajectory management.	
Family Deployment Approach	The implementation of this Family requires an analysis of upgrades and new implementations of services to be performed, as well as the development of a concept on how to tackle the transition for this Family.	

	This analysis shall include the development of a roadmap of the transition and the identification of the relevant artefacts (Roadmap, services definition, AIRM version, XM models, Profiles, Safety and Security framework, compliance framework) (**MM1 – Transition concept from legacy protocol (AFTN…) to SWIM**). While the transition concept is expected to be produced once for all concerned services, the individual services may have different implementation roadmaps. Thus, they can reach the milestones at different points in time. The service interfaces to either provide or consume the Family 5.6.1 services shall be developed and integrated with the systems providing or consuming the data exchanged by these services **(MM2 – New implementation or upgrade of services for Yellow Profile developed)** shall be developed. The service interfaces and the integration with the data-providing or –consuming systems shall then be validated **(MM3 – New implementation or upgrade of services for Yellow Profile validated)**. The deployment of the services required by Family 5.6.1 using Yellow Profile shall be planned, in terms of operation, with other Stakeholders, such as NM, ANSPs, AUs, Airport Operators, etc. **(MM4 – Planning of communications Yellow Profile deployment completed)**. The execution of such activities is expected to lead to the start of operational use by the Operational Stakeholders Yellow Profile **(MM5 – Implementation Yellow Profile completed)**. When implementing SWIM, each stakeholder has to take into account the requirements stemming from the safety and security assessment at functional level required by its respective NSA.

Family 5.6.2 – Upgrade / Implement Flights Information Exchange system / service supported by Blue Profile

5.6.2 – Upgrade / Implement Flights Information Exchange system / service supported by Blue Profile			
Main Sub-AF	Sub-AF 5.6 SWIM Flights Information Exchange		
Readiness for implementation	Medium: the readiness will become High after the validation of the IOP solution based on the updated versions of ED 133 and the Blue Profile.		
Initial Operational Capability	01/06/2018	**Full Operational Capability**	01/01/2025

Description and Scope

Commission Implementing Regulation (EU) No 716/2014 stipulates the following with regard to Flight Information exchange: *[...] Flight information shall be exchanged during the pre-tactical and tactical phases by ATC systems and Network Manager. Operational stakeholders shall implement services which support the exchange of the following flight information as indicated in the table below using the blue SWIM TI Profile:*

- Various operations on a flight object: Acknowledge reception, Acknowledge agreement to FO, End subscription of a FO distribution, Subscribe to FO distribution, Modify FO constraints, Modify route, Set arrival runway, Update coordination related information, Modify SSR code, Set STAR, Skip ATSU in coordination dialogue

- Share Flight Object information. Flight Object includes the flight script composed of the ATC constraints and the 4D trajectory [...] Service implementations shall be compliant with the applicable version of AIRM, the AIRM Foundation Material and the ISRM Foundation Material.

System requirements:

- ATC systems shall make use of the flight information exchange services

This Family aims at implementing Flight Object Exchange systems and services in accordance with SWIM principles. The systems shall be implemented to support the Flight Object exchange in compliance with the Blue SWIM TI Profile over PENS1 / NewPENS as transport network and the official versions of ED133.

Due to the complexity of Flight Object, it is acknowledged that additional validations might have to be done to ensure interoperability. The service implementations shall further be compliant with the applicable version of the standardisation material which corresponds to the material mentioned in the Implementing Rule (AIRM, the AIRM Foundation Material and the ISRM Foundation Material), in particular the SWIM policies and the Eurocontrol SWIM Specifications.

The applicable version of these documents will at any time be available in the SWIM registry, which is maintained by the SWIM Governance. Appendix 1 contains a list of services that provide partial coverage of the Commission Implementing Regulation (EU) No 716/2014 based on services developed in the context of SESAR 1 or services deployed or planned by NM.

Once established, the SWIM Governance will be responsible for the maintenance and publication of this list to finally cover the full PCP scope; the up to date list of services will be available at any time in the registry managed by the SWIM Governance.

The registry will also contain the detailed specifications of the services (Service descriptions compliant with the published Eurocontrol specification) and the technical specifications related to the implementation (TI Profile specification, etc.), allowing consumers to develop applications using these services.

The civil Stakeholder systems shall be adapted to initially support the legacy information exchanges (e.g. AFTN, AMHS, FMTP …) and the SWIM Blue profile information exchanges simultaneously, allowing a smooth migration of the stakeholders to SWIM.

Security and availability shall be upgraded to support the strong dependencies caused by the system to system interactions. Stakeholder security shall be improved by conducting a security risk assessment and by establishing security monitoring and management tools and procedures.

The related ATM systems requiring Flight information shall be able to use the Flight information exchange services. Particular needs from the military must be considered, especially where for operational security reasons the information cannot and will not be shared.

Interdependencies		
Please refer to the Short-Term Deployment Approach (see details in Section 3) for information regarding dependencies to other AF5 families.		
Synchronization Needs		
The implementation of the Flight Object distribution and consumption shall be synchronized and coordinated at least by a big area like a FAB or neighbouring ANSPs. A roadmap for the regional implementation of Flight Object was coordinated, agreed and delivered under project INEA IP 2016_027_AF5 - "European Deployment Roadmap for Flight Object Interoperability"		
Civil / Military Coordination		
4D trajectory management as well as the identification process will benefit from a civil-military coordination to exchange flight object data.		
Stakeholders considered as gaps	ANSPs, Network Manager	
Other stakeholders involved in the Family deployment	Military Authorities	
Links to ICAO GANP ASBUs	B1-FICE Increased Interoperability, Efficiency and Capacity through Flight and Flow Information for a Collaborative Environment Step-1 (FF-ICE/1) application before Departure B2-FICE Improved Coordination through Multi-centre Ground-Ground Integration (FF ICE, Step 1 and Flight Object, SWIM)	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	CM-0201-A SESAR 2020
	ATM Master Plan Level 3 (Edition 2019)	INF08.2
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	SDM recommends that a cluster of ANSPs, a FAB or neighbouring ANSPs, present common Implementing Projects to implement FO - based on the two SWIM services ATC Flight Object Control Service and Shared Flight Object Service and ED133 versions - in their Airspace especially synchronized with Free Route implementation. SDM is available to help ANSPs and NM for building implementation scenarios.	
Family Deployment Approach	This Family is subject of validation under the SESAR 2020 Programme wave 1. Final validation results are expected by June 2020. The implementation of this Family requires an IOP implementation analysis of transitions and new implementations to be performed, as well as the development of a concept on how to tackle the transition for this Family. This analysis shall include the development of a roadmap of the transition and the identification of the relevant artefacts (Roadmap, services definition, AIRM version, XM models, Profiles, Safety and Security framework, compliance framework) **(MM1 – Transition concept from OLDI-FMTP to FO)**.	

	While the transition concept is expected to be produced once for all concerned services, the individual services may have different implementation roadmaps. Thus, they can reach the milestones at different points in time. The services required by Family 5.6.2 using Blue Profile **(MM2 – New implementation or upgrade of services for Blue Profile developed)** shall be developed. The services required by Family 5.6.2 using Blue Profile **(MM3 – New implementation or upgrade of services for Blue Profile validated)** shall be validated. The deployment of the services required by Family 5.6.2 using Blue Profile shall be planned, in terms of operation, with other Stakeholders: NM and ANSPs and potentially any other stakeholders planning to deploy Blue Profile flight information exchanges even if not mandated **(MM4 – Planning of communications Blue Profile deployment completed)**. The execution of such activities is expected to lead to the start of operational use by the Operational Stakeholders for Blue Profile **(MM5 – Implementation Blue Profile completed)**. When implementing SWIM each stakeholder has to take into account the requirements stemming from the safety and security assessment at functional level required by its respective NSA.

4.6 AF #6 – Initial Trajectory Information Sharing

Family 6.1.1 – ATN B1 based services in ATSP domain

6.1.1 - ATN B1 based services in ATSP domain			
Main Sub-AF	Sub-AF 6.1 Initial Trajectory Information Sharing		
Readiness for implementation	High		
Initial Operational Capability	Before 2014	**Full Operational Capability**	05/02/2018

Description and Scope

Air Ground Data Link capability according to Commission Regulation (EC) No 29/2009 on data link services is an essential prerequisite for Baseline 2 and particularly for Initial Trajectory Information Sharing. This regulation has been updated by Commission Implementing Regulation (EU) No 310/2015 and is complemented by Commission Regulation (EC) No 30/2009 on exchange of flight data (ground/ground) in support of data link services.

This Family encompasses:

- ATM system upgrades (FDP, HMI, Recording, Front end processor):
  - Processing of data link related flight plan information by the flight data processing system to support the association of data link communication with flight plans.
  - Processing and display of Data Link Initiation Capabilities (DLIC) service messages to support the establishment of CPDLC communication with the airborne systems, as well as the transfer of air/ground data link communication to other ATSUs.
  - Processing and display of Logon Forward (LOF) and Next Authority Notified (NAN) messages by the flight data processing system to support the transfer of air/ground data link communication between ATSUs.
  - Processing and display of ATC Communications Management (ACM) service messages to support the transfer of voice and data communications between sectors of the same ATSU and between different ATSUs.
  - Processing and display of ATC Clearances (ACL) service messages, including monitoring and supervision of dialogue states.
  - Processing of ATC Microphone Check (AMC) service messages to support controllers to simultaneously instruct all (data link connected) flight crews to check the status of their voice communication systems.
- Implementation of DLS performance monitoring system.
- ATN Interface providing connection to the air/ground communication network (see Family 6.1.3).
- Operations manuals updates to include working methods and operating procedures for the use of CPDLC.
- Training of ATCOs and technical staff.

Interdependencies

Family 6.1.3: Family 6.1.1 can only be implemented in conjunction with Family 6.1.3, which is providing the corresponding communication infrastructure for air/ground data link.

Synchronization Needs

Family 6.1.4 targets the implementation of avionic systems supporting ATN B1 applications. Therefore, synchronisation between ANSPs and AUs is necessary.

Civil / Military Coordination

In certain circumstances military ANSPs may provide ATS services to traffic where DLS is implemented. In those cases, military ATM systems must be also adapted (taking into account their specificity).

Stakeholders considered as gaps	ANSPs	
Other stakeholders involved in the Family deployment	Military authorities, when relevant	
Links to ICAO GANP ASBUs	B0-TBO Improved Safety and Efficiency through the Initial Application of Data Link En-route	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AUO-0301 Available
	ATM Master Plan Level 3 (Edition 2019)	ITY-AGDL
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	It is recommended to take into consideration Family 6.1.3 which is necessary to provide the required communication infrastructure.	
Family Deployment Approach	The implementation of the Family would require the upgrade of the existing ATM systems and/or installation of new systems (e.g., data link front end processor). Such systems would also require the provision of their final acceptance and the integration with other existing systems, considering that some of these components are included in Family 6.1.3 **(MM1 – ATM systems upgrade)**. The applicable concept of operations shall also be broken down into documented and approved work procedures **(MM2 – Procedures available)**. Before the start of the operational use of CPDLC based services, a safety assessment shall be performed successfully **(MM3 – Safety Assessment)** and all operational/technical staff involved shall be duly trained **(MM4 – Training)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM5 – Implementation completed)**.	

Family 6.1.2 – ATN B2 based services in ATSP domain

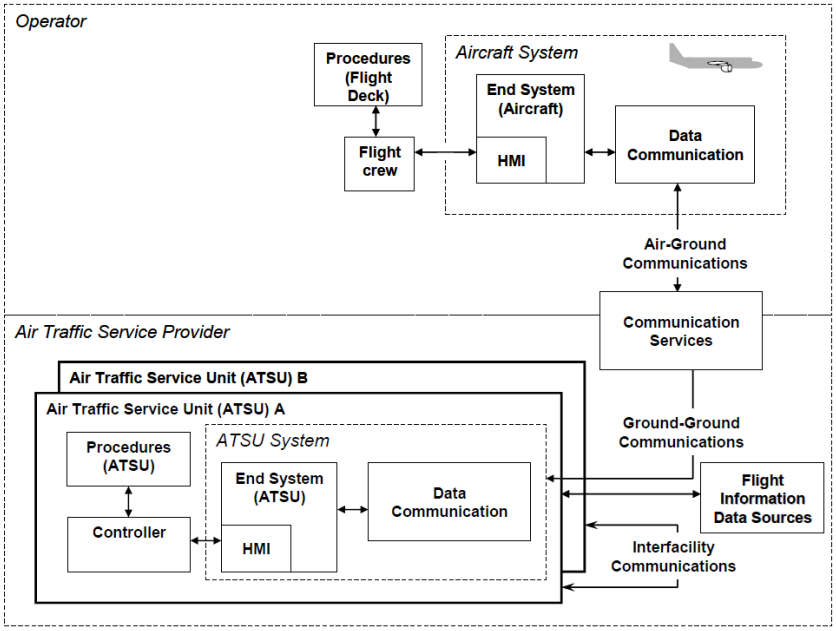
6.1.2 ATN B2 based services in ATSP domain			
Main Sub-AF	Sub-AF 6.1 Initial Trajectory Information Sharing		
Readiness for implementation	Medium		
Initial Operational Capability	01/01/2020	**Full Operational Capability**	01/01/2025

Description and Scope

Adapt ANSP/NM ATM systems to process the air derived flight data provided by EPP. The new capabilities of the ATM system are:

- establishing and operating the appropriate ADS-C contract;
- processing and integration of EPP information in the ATM system; and
- exchanging EPP enhanced ground trajectory with other ATSUs.

These new functionalities will be allocated according to local architectures. The figure below represents an overview of the CNS/ATM system as per RTCA/EUROCAE.



On the basis of this model the following allocations can be assumed:

- ATSU (Air Traffic Service Unit) System:
  - Determine parameters for the appropriate ADS-C Contract Request
  - Process EPP data in FDP to derive performance benefits (includes FDP Trajectory Prediction, HMI, Controller support tools, Safety Nets as appropriate)
- NM Systems:
  - Process and integrate EPP data to derive network performance benefits
- ATSU Data Communication
  - Establish the appropriate ADS-C Contract with Aircraft System either directly or through delegation to an appropriate external function of Communication Services (involves Datalink Front End Processor (DL-FEP) and/or interfaces to external functions as appropriate) Note: The use of a central ADS-C server rather than using a local FEP at each ANSP should be considered.
  - Provide support for SWIM enabled interfacility sharing of EPP or EPP enhanced ground trajectory data.
- Communication Services

Interdependencies
Family 5.6.2 - "Upgrade / Implement Flights Information Exchange system / service supported by Blue Profile", which implements the Flight Object (FO), is required by Family 6.1.2 due to the dependency laid down in the requirements of the PCP regulation for inter-ATSU and ATSU-NM communication. Stakeholders implementing Family 6.1.2 have to implement Family 5.6.2 at the same time. Family 6.1.3 is an important prerequisite, providing the physical and logical network infrastructure for ATN Air/Ground communication. Therefore, stakeholder implementing Family 6.1.2 are suggested to internally coordinate the implementation of these two families.
Synchronization Needs
Implementation of this Family should be coordinated with neighbouring stakeholders to achieve a synchronized implementation, avoiding geographical "holes" in the communication with aircraft. Family 6.1.5 provides the airborne capabilities to enable downlink of EPP data from the aircraft systems. Coordination with major European airlines is advisable to ensure that the target equipage rate of at least 20% of aircraft operating within ECAC countries can be achieved.
Civil / Military Coordination
This Family must also support interoperability needs of military/state transport-type aircraft deemed to be ADS-C EPP capable.

Stakeholders considered as gaps	ANSP, NM	
Other stakeholders involved in the Family deployment	Military authorities when relevant	
Links to ICAO GANP ASBUs	B1-TBO Improved Traffic Synchronization and Initial Trajectory-based Operation	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	IS-0303-A (ER APP ATC 149a, ER APP ATC 119) SESAR Release 5 IS-0303-A (ER APP ATC 100) SESAR Release 9
	ATM Master Plan Level 3 (Edition 2019)	None
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	Considering the current status of development work, SDM considers that the concept of EPP usage still needs to be validated at SJU level. It is recommended to take into consideration Family 6.1.3 which is necessary to provide the required VDL Mode 2 communication infrastructure.	
Family Deployment Approach	Implementing partners shall equip their respective systems with the required functionalities **(MM.1 - System Upgrade to support the acquisition and management of EPP data in the ground systems)**. This step shall be followed with a safety assessment campaign concluding on a safety assessment report providing a basis for an operational approval **(MM.2 – Safety Assessment)**.	

	Upgraded systems shall be integrated in the existing systems **(MM.3 – Integration)**. The applicable concept of operations shall also be broken down into documented and approved work procedures **(MM.4 – Procedures available)** and all operational/technical staff involved shall be duly trained **(MM.5 – Training of OPS and technical staff)**. The execution of such activities is expected to lead to the start of permanent operational use **(MM.6 – Implementation completed)**.

Family 6.1.3 – A/G and G/G Multi Frequency DL Network in defined European Service Areas

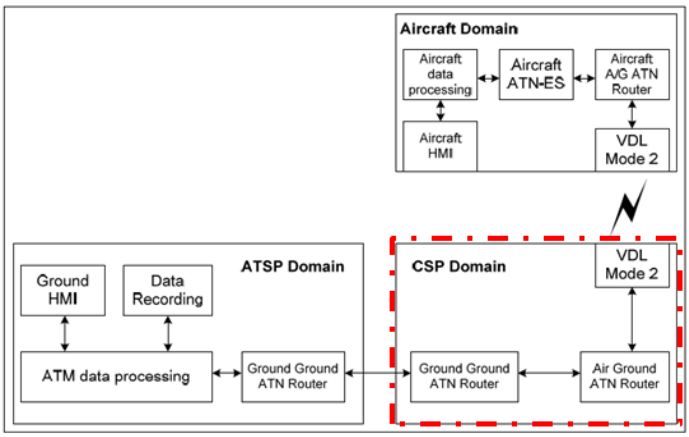
6.1.3 A/G and G/G Network Multi Frequency DL Network in defined European Service Areas			
Main Sub-AF	Sub-AF 6.1 Initial Trajectory Information Sharing		
Readiness for implementation	High		
Initial Operational Capability	01/01/2017	**Full Operational Capability**	31/12/2022

Description and Scope

Based on the results of the ELSA study, SDM developed the "Data Link Services (DLS) Implementation Strategy towards Initial Trajectory Information Sharing", that was further elaborated into the "Data Link Services (DLS) Recovery Plan". This DLS Recovery Plan focuses on the implementation of the ELSA recommendations that take effect in the communication domain (Family 6.1.3) and aircraft domain (Family 6.1.4).

Based on the DLS Recovery Plan, EC mandated SDM to act as the Data Link Services (DLS) Implementation Project Manager. To support the implementation of the DLS Recovery plan, EC has also requested EASA, EUROCAE and NM to act on specific gaps identified by ELSA.

The Family 6.1.3 is related to the A/G and G/G Multi Frequency (MF) DL Network in defined European Service Areas[26], consisting in the European implementation of the A/G and G/G Network based on European Service Areas and VDL Mode 2 as part of ATN COM (COMmunication) domain components as identified in the following ETSI Architecture (highlighted in red in the picture):



ATN Data Link System Architecture (ETSI EN 303 214)

The ATN COM domain, identified in the previous picture, supports ATN B1 services and trajectory downlinks with EPP (part of ATN B2 services) and is composed by:

- the VDL M2 network;
- the ATN routing components (Ground/Ground ATN and Air/Ground ATN Routers).

The related ATN COM infrastructure can be split in two segments:

- Air-Ground (A/G) network that is the Radio Frequency (RF) network based on VDL M2[27] and,
- Ground-Ground (G/G) network[28] that is composed by:
  - ATN routing components and
  - ATS data distribution network needed to connect:
    - the ATN routing components among them
    - the ATN routing components with the A/G network and with ATSP domain.

[26] Portions of airspace, homogeneous in terms of operational and technical needs to provide data-link services in a safe, secure and efficient way. They could be identical with FABs or as new entities established regardless of state boundaries.
[27] This network is used also for ACARS messages (ACARS over AVLC - AoA) as in each aircraft is possible to open only one VDL M2 communication session for both ATS and AOC services).
[28] The AOC messages transport is not considered here.

Currently, ATN Data Link systems, based on VDL M2, are already implemented in some European Countries, but performance issues (provider and user aborts) have been experienced during the operational use of ATN B1 services making it difficult to continue to use them in the current configuration.

With this regard, the EC has requested:

- a technical investigation to EASA, resulting in the elaboration of a specific Report (Technical Issues in the implementation of Regulation EC 29/2009) which identifies the causes of the current DLS issues;
- a technical study to SJU - ELSA Study (VDL Mode 2 Measurement, Analysis and Simulation Campaign) - in order to analyse the causes of the current DLS issues and identify solutions.

The EASA Report clearly identified that the use of a single frequency (the CSC channel alone, used for AOC as well as ATS data) was one of the most important root causes of the technical problems. So, the needs to meet the ATS performances have led the aeronautical community to consider upgrading the current single frequency VDL M2 networks by developing and deploying multi-frequency infrastructures, as requested by ICAO standards (also the SJU Capacity Study confirmed the single frequency saturation in core Europe starting from 2015).

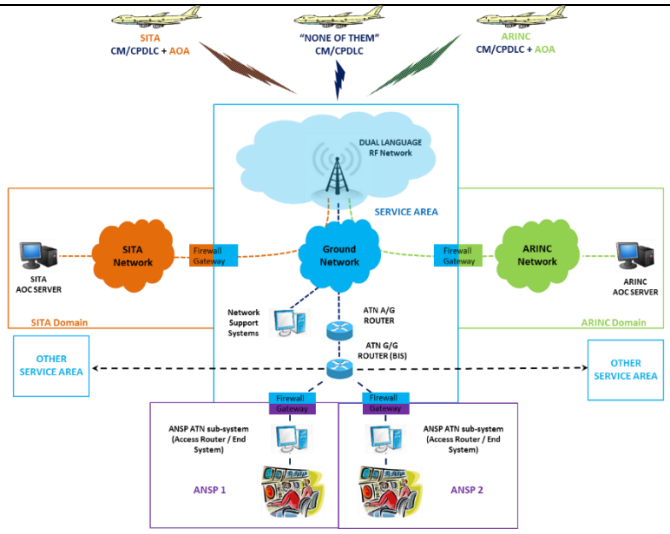
Starting from the EASA report, the following Ground Network recommendations have been elaborated by ELSA:

- improve the VHF Ground Station (VGS) network and fix the ground system issues:
  - use a dedicated channel for transmissions at the airport in regions with high traffic levels in en-route;
  - use alternative communication means for AOC in the airport domain (e.g., Wi-Fi, cellular, AeroMACS) to off-load the frequencies used for CPDLC;
  - progressively implement additional VDL2 frequencies in accordance with the traffic level;
  - optimise the en-route VGS network coverage;
  - ensure the availability of a fifth VDL2 frequency (at a minimum);
  - use the CSC as common control channel only, unless traffic level is very low;
  - implement ELSA recommended protocol optimisation: limit AVLC frame size;
  - fix the ELSA identified ground system problem;
- start implementing the transition roadmap to the MF VDL2 target technical solution: introduction of alternate channels using reserved frequencies[29], addition of frequencies, and transition to one managed MF VDL2 network per Service area.

With reference to the last, ELSA Study, after a technical assessment of the various MF deployment identified options, concluded that **the best model for MF deployment in Europe is a model comprising a number of Service Areas, where all VDL M2 Ground Stations (VGS) operating on VDL frequencies in a given Service Area work together under one unique frequency licensee responsible for managing the traffic on the RF network**. Thus, the European architecture is based on a "Service Areas" approach that, from a pure technical point of view, means a European distributed architecture.

Such model – named ***Model D*** - represents the target high level architecture solution for the ATN COM infrastructure outlined in the following picture:

[29] Means that all ground stations operating on that VDL frequency in a given Service area work together under one unique frequency licensee responsible for managing the traffic on the RF network.



Target high level architecture solution for the ATN COM infrastructure

Model D description:

As outlined in the previous figure, the model D consists of a European distributed architecture based on Service Areas.

For each Service Area, the following components are included:

- RF network: MF VDL M2 VGS implementing Dual Language[30] technology
- Ground network: IP network for internal and external components connections (the AOC transport is not considered in the Family scope)
- ATN Ground Network: composed by ATN A/G and G/G routers in a dedicated ATN domain
- Network support systems: monitoring, recording, billing and network management systems
- Network interfaces: Firewall/Gateways for external interfaces.

It is worth noting that, at European Level, Network Support Systems should be envisaged to ensure an overall monitoring supporting the Common DL Service provision.

One of the most important element of the Model D is its scalability, that means the possibility to add new frequency, also only one, each time the available bandwidth becomes insufficient in the Service Area as well as in the Country/Region within the Service Area (the number of frequencies "linearly" grows with the traffic increase).

Regarding to the ground networking (Ground Network and ATN Ground Network), a possible common approach is to implement the G/G network ATN rationalization for DLS based on PENS use and considering also the Service Area approach as defined in the TEN-T study "New European Common Service Provision for PENS 2 and DLS".

Towards Model D:

Having defined the European target solution architecture for the ATN COM infrastructure, also the transition from the current situation to the target solution has been studied by ELSA. The European current situation can be represented by three different statuses which can be assumed as starting points for the transition:

- **"Model A":** a country/region with a multiple VDL M2 networks implemented in the same airspace, using a One-GSIF[31] system on common frequencies;
- **"Model C":** a country/region with a single VDL M2 network implemented in the same airspace, using a Two-GSIF system on reserved frequencies;

30 "Single Language" means that any VGS broadcasts the ID (Identifier) of only one (Single) Digital Service Providers. "Dual Language" means that any VGS broadcasts the IDs (Identifier) of multiple (Dual) Digital Service Providers in its Ground Station Information Frames (GSIF) on the RF channel.

31 A One-GSIF system implements the "Single Language". A Two-GSIF system implements the "Dual Language".

- **No implementation yet**: a country/region that has not implemented any ATN COM infrastructure.

Due to the need to consider:

- the existing infrastructure;
- the time required to move forward the technical target solution (assuming that some of the current infrastructures are in operation)

a transition model, named "Model B", has been introduced.

Model B description:

Model B consists of **Multiple VDL M2 networks implemented in the same airspace using a One-GSIF system on reserved frequencies with MF implementation.**

To make it possible to implement the Model B in a way suitable to meet the requirements, five frequencies have been assigned to VDL Mode 2 by the ICAO EANPG FMG. **The Model B has to be considered as a temporary step to reach the Model D.**

The following table recaps the Models described above:

Model	VDL RF operating Networks	VDL RF Frequency Use	GSIF on each Frequency announced by each Network	Note
A	MULTIPLE	COMMON	ONE	Original Central EU model
B	MULTIPLE	RESERVED	ONE	**Target Short term evolution**
C	SINGLE	RESERVED	TWO	Model originally deployed in a limited area[32]
D	SINGLE	RESERVED	TWO	**Target Long term model for EU VDL network evolution**

Stakeholders involved:

The stakeholders involved in the Family implementation are *ANSPs and CSPs* that are asked to provide:

- in the short term, coverage and performance required to satisfy the DLS IR 29/2009 (ATN B1 services), amended by IR 310/2015 and considered as prerequisite for PCP;
- in the medium term, capacity to support the increased data volume expected with the introduction of trajectory downlinks with EPP (part of ATN B2 services) for Initial trajectory information sharing (i4D) as requested by PCP.

In this perspective, the SDM DL strategy has proposed to EC to achieve the target Model D by December 2022.

Interdependencies

Family 6.1.3 improves the ground part of the Air/Ground communication infrastructure that is required by families 6.1.1 and 6.1.4. Furthermore, it provides/improves Air/Ground communication capabilities supporting families 6.1.2 and 6.1.5. Therefore, stakeholders implementing any of the AF6 families are suggested to synchronize these activities with Family 6.1.3 activities.

Synchronization Needs

As the Air/Ground communication infrastructure provided/improved by Family 6.1.3 affects components that are part of a European network connecting ANSPs and AUs through CSPs, *all* stakeholders have to

[32] Currently deployed by ENAV on Italian airspace.

synchronize their activities to ensure a harmonized and homogeneous deployment/improvement of the network. As Family 6.1.3 affects communication infrastructure used by all other AF6 families, these families should synchronize with Family 6.1.3. This affects all stakeholders, including CSPs.	
Civil / Military Coordination	
No special requirements.	
Stakeholders considered as gaps	ANSPs
Other stakeholders involved in the Family deployment	CSPs
Links to ICAO GANP ASBUs	B0-TBO Improved Safety and Efficiency through the Initial Application of Data Link En-route
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**: N/A **ATM Master Plan Level 3 (Edition 2019)**: ITY-AGDL
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.
Recommendations for IPs proposal	Refer to *DLS Recovery Plan*.
Family Deployment Approach	Deployment of Family 6.1.3 is divided into two phases: Transition from Model A or C to Model B or C with MF in the first phase, and the transition from model B or Model C with MF to Model D. Moreover, it is worth noting that, as a matter of fact, today in Europe, only two DSP IDs (ARINC and SITA) are used for the messages announcement on a VDL M2 channel and, for this reason, they will be used for the family deployment approach. <u>For the phase one transition to Model B and Model C with MF (Milestones at Country Level)</u> Based on the current distribution of VGSs and frequencies, a target design for the deployment of new VGSs and frequencies and for the ground network components to provide DLS to aircraft using ARINC identifier, is developed **(MM1 - A/G and G/G network design completed to provide DLS to aircraft using ARINC identifier**). This is followed by the procurement and deployment of the VGSs and ground network components to provide DLS to aircraft using ARINC identifier **(MM2 - A/G and G/G network deployment completed to provide DLS to aircraft using ARINC identifier**). At the end of these activities, the modified/additional components are integrated into the operational network including the administrative process in order to provide DLS to aircraft using ARINC identifier (**MM3 – Operational transition completed including the administrative process in order to provide DLS to aircraft using ARINC identifier**). Based on the current distribution of VGSs and frequencies, a target design for the deployment of new VGSs and frequencies and for the ground network components to provide DLS to aircraft using SITA identifier, is

	developed (**MM4 - A/G and G/G network design completed to provide DLS to aircraft using SITA identifier**). This is followed by the procurement and deployment of the VGSs and ground network components to provide DLS to aircraft using SITA identifier **(MM5 - A/G and G/G network deployment completed to provide DLS to aircraft using SITA identifier**). At the end of these activities, the modified/additional components are integrated into the operational network including the administrative process in order to provide DLS to aircraft using SITA identifier (**MM6 – Operational transition completed including the administrative process in order to provide DLS to aircraft using SITA identifier**). <u>For Model D implementation (Milestones at Service Areas and European Level)</u> Based on the design from phase one and taking into account the single network design in a service area, the layout of service areas is defined and an optimized target design for the (re)deployment of VGSs and frequencies is developed (**MM7 – A/G network design at Service Area level completed**). The same analysis and design is performed for the ground network components required to support the A/G network (**MM8 – G/G Network design at Service Area level completed**). As a result of the A/G network design at Service Area level, VGSs and frequencies may have to (re)distributed in boundary areas (**MM9 – VGSs upgraded at Service Area level**). The ground system components required to interconnect the service areas are deployed or upgraded (**MM10 – G/G network upgraded at Service Area level**). A/G and G/G networks optimized for the service areas are connected/integrated into the operational network (**MM11 – Operational transition at Service Area level**). Based on the overall layout of the service areas, refinement of the design for the (re)deployment of VGSs and frequencies in boundary areas is developed (where necessary) (**MM12 – A/G network design at European level completed**). The analysis and design to interconnect the service areas at a European level is performed (**MM13 – G/G network design at European level completed**). The service areas have to be interconnected to operate at a European level (**MM14 – Integration of Service Areas at European level**). At the end of phase two, the optimized networks are integrated into an operational pan-European network (**MM15 – Operational transition completed**).

Family 6.1.4 – ATN B1 capability in Multi Frequency environment in Aircraft domain

6.1.4 - ATN B1 capability in Multi Frequency environment in Aircraft domain			
Main Sub-AF	Sub-AF 6.1 Initial Trajectory Information Sharing		
Readiness for implementation	High		
Initial Operational Capability	01/09/2016	**Full Operational Capability**	05/02/2020

Description and Scope

Based on the results of the ELSA study, SDM developed the "Data Link Services (DLS) Implementation Strategy towards Initial Trajectory Information Sharing", that was further elaborated into the "Data Link Services (DLS) Recovery Plan". This DLS Recovery Plan focuses on the implementation of the ELSA recommendations that take effect in the communication domain (Family 6.1.3) and aircraft domain (Family 6.1.4). Based on the DLS Recovery Plan, EC mandated SDM to act as the Data Link Services (DLS) Implementation Project Manager. To support the implementation of the DLS Recovery plan, EC has also requested EASA, EUROCAE and NM to act on specific gaps identified by ELSA.

The purpose of this Family is for civil and military aircraft operators concerned by DLS IR to upgrade to "best in class" avionic configurations as prescribed by ELSA and/or those having successfully passed subsequent and equivalent test and certification activities. One of the outcomes of ELSA was a set of avionic configurations that were tested and demonstrated as sufficient to comply with the ATN/VDL2 performance expectations in multi-frequency (MF) environment. ELSA Final report (D11) refers to this set as "best in class"; select aircraft type families are covered, see below.

ELSA identified the need to continue testing efforts beyond the lifespan of the study itself to cover both newly emerging avionic configurations as well as other existing configurations that were not covered in the ELSA study. ELSA proposed that ultimately, an effective end to end certification process for both ground and air components should be defined and implemented. The current airborne routers and VHF Data Radio already labelled as "best in class" in the frame of the ELSA project are listed below:

1) Data Link Management Units (airborne routers)

- AIRBUS FANS B+ ATSU CSB8
- HONEYWELL
  - MkII+ CMU upgrade from -501 and -521 to -522
  - EPIC CMF upgrade to Block 3.xx or later
  - B787 CMF upgrade to BPV3
  - B777 CMF upgrade to BPv17A BLE
- Rockwell Collins CMU-900 operators should upgrade to CMU Core software 815-5679-505 (refer to CMU-900 Service Information Letter 15-1) in order to fix a software bug impacting the VDL2 Multi-Frequency operations.

2) On board VDR (VHF Data Radio)

- Honeywell
  - RTA-50D PN 965-1696-0F1
  - RTA-44D PN 064-50000-2052 or with service bulletin SB23-1570 installed
  - EPIC avionics fitted with mod D or greater for the VDR element.
- Rockwell Collins
  - VHF-920: P/N 822-1250-002w/SB16 or 822-1250-020w/SB17
  - VHF-2100: P/N 822-1287-101/180w/SB7 or 822-1287-121/141
  - VHF-2200 P/N 822-2763-020 or VHF-2200 P/N 822-2763-050

Note: Regardless of the Family's readiness for deployment, one outcome of the ELSA study is the need for an effective end-to-end system certification process including both ground and air components and reference material for the ground network infrastructure. Need to accelerate the delivery of supporting material.

Interdependencies
Family 6.1.3 affects the ground components of the Air/Ground communication infrastructure required by this Family. As the overall network performance is depending on both the ground and airborne equipment, stakeholders are suggested to follow Family 6.1.3 activities.
Synchronization Needs
Airspace users planning to upgrade their avionics to systems not identified as "best in class" may coordinate their activities with other airspace users in the same position (or with manufacturing industry) to achieve synergies regarding "best in class" testing. Alternatively, they could await the publication of ED-92C and the availability of products certified against this revision of the standard, which will reflect aspects of the "best in class" testing.
Civil / Military Coordination
Particular needs from the military must be considered, when justified by civil-military interoperability needs.

Stakeholders considered as gaps	Airspace Users	
Other stakeholders involved in the Family deployment	Military authorities, when relevant (as AU)	
Links to ICAO GANP ASBUs	B0-TBO Improved Safety and Efficiency through the Initial Application of Data Link En-route	
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	AUO-0301 Available
	ATM Master Plan Level 3 (Edition 2019)	ITY-AGDL
Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.	
Recommendations for IPs proposal	It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.	
Family Deployment Approach	The deployment of this Family is envisaged to commence with the procurement of required equipment or upgrade packages; this step is completed when the operator has taken delivery of all necessary hardware and software components **(MM.1 - Equipment procured)**. This step is followed by installation and integration in onboard systems of all aircraft in the respective fleet **(MM.2 - Aircraft equipped)**. Next step involves the elaboration and approval process of operational procedures and training packages **(MM.3 – Procedures and training available)**. Crews must undergo appropriate training with respect to the use of the equipment **(MM.4 – Training completed)**. Finally, the Family is fully implemented when regular operations have commenced on a permanent basis **(MM.5 – Implementation completed)**.	

Family 6.1.5 – ATN B2 in Aircraft domain

6.1.5 – ATN B2 in Aircraft domain			
Main Sub-AF	Sub-AF 6.1 Initial Trajectory Information Sharing		
Readiness for implementation	High		
Initial Operational Capability	01/04/2019	**Full Operational Capability**	01/01/2026
Description and Scope			
According to the PCP, one objective of AF6 is that "at least 20 % of the aircraft operating within the airspace of European Civil Aviation Conference (ECAC) countries in the ICAO EUR region corresponding to at least 45 % of flights operating in those countries, are equipped with the capability to downlink aircraft trajectory using ADS-C EPP as from 1 January 2026". This Family aims at adapting aircraft systems to receive and process a ground initiated ADS-C Contract Request for EPP data. The avionic system shall, at the minimum, implement all EPP Data Operational Requirements [EPP DATA OR] listed in Annex B of ED-228A. This Family encompasses: - Aircraft equipage - Procedures and training			
Interdependencies			
Family 6.1.3 affects the ground components of the Air/Ground communication infrastructure supporting this Family. As the overall network performance is depending on both the ground and airborne equipment, stakeholders are suggested to follow Family 6.1.3 activities.			
Synchronization Needs			
Family 6.1.2 implements the ATM functionalities making use of the data provided by this Family. Therefore, implementation of this Family should be coordinated with all ANSPs to ensure interoperability of the new airborne equipment with the existing ground systems.			
Civil / Military Coordination			
Particular needs from the military must be considered, when justified by civil-military interoperability needs.			
Stakeholders considered as gaps	Airspace Users		
Other stakeholders involved in the Family deployment	Military authorities, when relevant (as AU)		
Links to ICAO GANP ASBUs	B1-TBO Improved Traffic Synchronization and Initial Trajectory-based Operation		
ATM Master Plan References	**ATM Master Plan Level 2 (Dataset 19)**	IS-0303-A (A/C-37a) SESAR Release 5	
	ATM Master Plan Level 3 (Edition 2019)	None	

Cyber security requirements	SDM believes that this Family can be exposed to cyber security risks. It is therefore necessary to conduct a proper risk-based security assessment prior to any system update. Stakeholders shall assess these risks and apply appropriate security controls to mitigate them. The risk assessments and the resulting mitigations must be documented.
Recommendations for IPs proposal	It is recommended to take into consideration the results of Gap Analysis provided within the Monitoring View.
Family Deployment Approach	The deployment of this Family is envisaged to commence with the procurement of required equipment or upgrade packages; this step is completed when the operator has taken delivery of all necessary hardware and software components **(MM.1 - Equipment procured)**. This step is followed by installation and integration in on-board systems of all aircraft in the respective fleet **(MM.2 - Aircraft equipped)**. Next step involves the elaboration and approval process of operational procedures and training packages **(MM.3 – Procedures and training available)**. Crews must undergo appropriate training with respect to the use of the equipment **(MM.4 – Training completed)**. Finally, the Family is fully implemented when regular operations have commenced on a permanent basis **(MM.5 – Implementation completed)**.

4.7 Appendix 1 – List of services covering Reg. (EU) No. 716/2014

This Appendix contains a list of services that provide partial coverage of the Commission Implementing Regulation (EU) No 716/2014. It links the information exchanges listed in the regulation to the services developed in the context of SESAR 1 or to the services deployed or planned by NM, where applicable. The list is based on an interpretation of the PCP. It is compiled as guidance for stakeholders. These services are considered a starting point for PCP coverage in AF5. Note that it lies in the nature of SWIM that the service definitions will evolve through SWIM Governance based on stakeholder requirements. Thus, adaptations of the service implementations could be needed.

Information exchange requirement stated in PCP	SDP Family	Service resulting from SESAR 1	NM B2B service in Release 23/ NM B2B service in the NM Roadmap
AIM Domain			
Notification of the activation of an Airspace Reservation/Restriction (ARES)	#5.3.1 #3.1.1/2/3	ARES Activation	
Notification of the de-activation of an Airspace Reservation/Restriction (ARES)	#5.3.1 #3.1.1/2/3	ARES Deactivation	
Pre-notification of the activation of an Airspace Reservation/Restriction (ARES)	#5.3.1 #3.1.1/2/3	ARES Preactivation	
Notification of the release of an Airspace Reservation/Restriction (ARES)	#5.3.1 #3.1.1/2/3	ARES Release	
Query Airspace Reservation/Restriction (ARES) information	#5.3.1 #3.1.1/2/3	ARES Query	
Airspace Usage Plans (AUP, UUP) - ASM level 1, 2 and 3	#5.3.1 #3.1.1/2/3		ASM Level 1 part 1: Airspace / Airspace Structure already available
			ASM Level 2 fully covered by Airspace / Airspace Availability services
			ASM Level 1 part 2: Event Planning service planned for future Release ASM level 3 planned for future Release
Provides aeronautical information feature on request. Filtering possible by feature type, name and an advanced filter with spatial, temporal and logical operators.	#5.3.1 #1.2.2	Aeronautical Information Feature	
Provide Aerodrome mapping data	#5.3.1 #1.2.2	Aerodrome Map Information	
D-Notams	#5.3.1		

Information exchange requirement stated in PCP	SDP Family	Service resulting from SESAR 1	NM B2B service in Release 23/ NM B2B service in the NM Roadmap
MET Domain			
Meteorological prediction of the weather at the airport concerned, at a small interval in the future: - wind speed and direction - the air temperature - the altimeter pressure setting - the runway visual range (RVR)	#5.4.1	AirportMETNowcast[33] (ICAOMETLocalReport) (METAR) (TAF)	
Provide Volcanic Ash Mass Concentration	#5.4.1	VAMCInformation[34]	
Specific MET info feature service	#5.4.1	[35]	
Winds aloft information service	#5.4.1	MET Gridded Forecast	
Meteorological information supporting Aerodrome ATC & Airport Landside process or aids involving the relevant MET information, translation processes to derive constraints for weather and converting this information in an ATM impact. The system capability mainly targets a "time to decision" horizon between 20 minutes and 7 days.	#5.4.1	SNOWTAM METAR ICAOMETLocalReport AirportMETObservation AirportMETForecast AirportMETNowcast TAF AirportMETAlert AirportMETInducedCapacityReduction	
Meteorological information supporting En Route / Approach ATC process or aids involving the relevant MET information, translation processes to derive constraints for weather and converting this information in an ATM impact. The system capability mainly targets a "time to decision" horizon between 20 minutes and 7 days.	#5.4.1	METHazardEnrouteForecast METHazardEnrouteObservation MET Gridded Forecast	
Meteorological information supporting Network Information Management process or aids involving the relevant MET information, translation processes to derive constraints for weather and converting this information in an ATM impact. The system capability mainly targets a "time to decision" horizon between 20 minutes and 7 days.	#5.4.1	SNOWTAM METAR ICAOMETLocalReport AirportMETObservation AirportMETForecast AirportMETNowcast TAF AirportMETAlert METHazardEnrouteForecast METHazardEnrouteObservation MET Gridded Forecast	

Information exchange requirement stated in PCP	SDP Family	Service resulting from SESAR 1	NM B2B service in Release 23 / NM B2B service in the NM Roadmap
Network Domain			
Regulations	#5.5.1		Flow/Measures services provide read access to regulations and allow to create, update, revoke regulation proposals (MCP and normal regulations)
			Scenario Repository read-only services Additional services planned for a future release
Slots	#5.5.1		ATFM slot data exchange services planned for future Release
Short term ATFCM measures (STAM) - see also AF #4.1.1	#5.5.1 #4.1.1/2		Flow/Measures services for the management of MCP regulations and Flow/MCDM services
ATFCM congestion points	#5.5.1		Flow/Tactical Updates hotspot management service (trial mode)
Restrictions	#5.5.1		Airspace / AirspaceStructure / Restrictions feature
Network and En-Route Approach Operation Plans	#5.5.1		Flow/TacticalUpdates - Sector Configuration Plan - Runway Configuration Plan - OTMV Plan - Capacity Plan - Traffic Volume Activation Plan
			Network Events planned for future release.
Maximum airport capacity based on current and near-term weather	#5.5.1	Airport MET Induced Capacity Reduction	
AOP NOP synchronisation	#5.5.1 #4.2.4 #2.1.3 #2.1.4		Flight / Flight Management / DPI[36] services
			Arrival Planning Information, Extended Departure Planning Information in trial mode, AOP strategic plan services are planned for a future release
Airspace Structure, Availability and Utilisation	#5.5.1		Airspace/Airspace Structure

[33] Only the AirportMETNowcast service covers all the parameters mentioned in the regulation. Note that EUMETNET does not use Nowcasts anymore, so the service might be replaced.
[34] This service has only been identified and was not implemented
[35] While the *Specific MET Info Feature* service is mentioned explicitly in the regulation, it overlaps with the 3 generic MET information categories below.
[36] These services are considered to be a starting point. They will evolve based on AF2 (Family 2.1.4 Initial AOP) and AF4 (Family 4.2.2 Interactive Rolling NOP and Family 4.2.4 AOP-NOP Information Sharing).

			Airspace/Airspace Availability

Information exchange requirement stated in PCP	SDP Family	Service resulting from SESAR 1	NM B2B service in Release 23/ NM B2B service in the NM Roadmap
Flight Domain			
Various operations on a flight object: Acknowledge reception, Acknowledge agreement to FO, End subscription of a FO distribution, Subscribe to FO distribution, Modify FO constraints, Modify route, Set arrival runway, Update coordination related information, Modify SSR code, Set STAR, Skip ATSU in coordination dialogue	#5.6.2	ATC Flight Object Control	
Share Flight Object information. Flight Object includes the flight script composed of the ATC constraints and the 4D trajectory	#5.6.2	Shared Flight Object	
Validate flight plan and routes	#5.6.1		Flight/FlightPreparation services available in ICAO 2012 format, eFPL format and FIXM 4.1
Flight plans, 4D trajectory, flight performance data, flight status	#5.6.1 #4.2.3		Flight/FlightFiling services in ICAO 2012 format, eFPL format and FIXM4.1
Flights lists and detailed flight data	#5.6.1		Flight/FlightManagement services
Flight update message related (departure information)	#5.6.1		Flight update messages Flight/Flight Management/DPI services
Link to other AFs			
Arrival constraints exchange between ATS Units	#1.1.2	Arrival Management Information	
		Departure Planning Information	
ADS EPP downlink and distribution	#6.1.2	Report Aircraft Trajectory	
		Shared Flight Object	

5. List of Acronyms

Acronym	Meaning
A/G	Air / Ground
ACC	Area Control Center
A-CDM	Airport – Collaborative Decision Making
ACH	ATC flight plan Change Message
ACL	ATC Clearance
ACM	ATC Communications Management
ADS-C	Automatic Dependent Surveillance – Contract
AF	ATM Functionality
AFP	ATC Flight Plan
AFTN	Aeronautical fixed telecommunication network
AFUA	Advanced Flexible Use of Airspace
AIM	Aeronautical Information Management
AIRM	Aeronautical Information Reference Model
AIXM	Aeronautical Information Exchange Model
AMA	Arrival Management Message
AMAN	Arrival Manager
AMC	ATC Microphone Check
AMHS	ATS Messages Handling System
ANSP	Air Navigation Service Provider
AoR	Area of Responsibility
APCH	Approach
APL	ATC Flight PLan message
APOC	Airport Operations Centre
APW	Area Proximity Warning
ARES	Airspace Restrictions
ASBU	Aviation System Block Upgrades
ASM	AirSpace Management
A-SMGCS	Advanced Surface Movement Guidance and Control Systems
ATC	Air Traffic Control
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
ATSU	Air Traffic Service Unit
AU	Airspace Users
AUP	Airspace Usage Plan
AVOL	Aerodrome Visibility Operational Level
B2B	Business 2 Business
BCA	Bridge Certificate Authority
BFD	Basic Flight Data
CA	Certificate Authority
CACD	Central Airspace and Capacity Database
CBA	Cost Benefit Analysis
CDI	Course Deviation Indicator
CDM	Collaborative Decision Making
CDR	Conditional Route

Acronym	Meaning
CEF	Connecting Europe Facility
CFD	Change Flight Data
CFSP	Computer Flight Planning Service Providers
CHMI	Collaboration Human Machine Interface
CONOPS	Concept of Operations
COP	Coordination Point
CORA	Conflict Resolution Assistant
CPA	Common Procurement Agreement
CPDLC	Controller Pilot Data Link Communications
CPR	Correlated Position Report/Correlative Position Radar
CPTF	Common Procurement Task Force
CRL	Certificate Revocation Lists
CSP	Communication Service Providers
CTD	Constant Time Delay
CTOT	Calculated Take-off Time
CWP	Controller Working Position
DCT	Direct Routings
DLIC	Data Link Initiation Capabilities
DLS	Data Link Services
DMA	Dynamic Mobile Area
DMAN	Departure Management
DP	Deployment Programme
DPI	Departure Planning Information
EAD	European AIS Database
EASA	European Aviation Safety Agency
ECAC	European Civil Aviation Conference
EFD	EFTMS Flight Data
eFPL	Extended Flight Plan
EFS	Electronic Flight Strips
ETFMS	Enhanced Tactical Flow Management System
EGNOS	European Geostationary Navigation Overlay Service
EPP	Extended Projected Profile
ERNIP	European Route Network Improvement Plan
ESOs	European Standardization Organizations
eTOD	electronic Terrain and Obstacle Data
EU	European Union
FAB	Functional Airspace Blocks
FANS	Future Air Navigation System
FB	Functional Block
FBZ	Flight Plan Buffer Zones
FDP	Flight Data Processing
FEP	Front End Processor
FF-ICE	Flight and Flow — Information for a Collaborative Environment
FL	Flight Level
FMP	Flow Management Position
FOC	Full Operational Capability
FPL	Flight Plan
FRA	Free Route Airspace

Acronym	Meaning
FRT	Fixed Radius Turn
FSA	First System Activation
FUA	Flexible Use of Airspace
FUM	Flight Update Message
G/G	Ground / Ground
GANP	Global Air Navigation Plan
GNSS	Global Navigation Satellite System
HMI	Human Machine Interface
i4D	Initial 4-D
iAOP	Initial Airport Operations Plan
ICAO	International Civil Aviation Organization
IFPS	Integrated Initial Flight Plan Processing System
ILS	Instrument Landing System
IOC	Initial Operational Capability
IOP	Interoperability
IP	Implementation Project
ISRM	Information Service Reference Model
iSWIM	Initial System Wide Information Management
IWXXM	ICAO Meteorological Information Exchange Model
KPI	Key Performance Indicator
LNAV	Lateral Navigation
LOA	Letter of Agreement
LPV	Localizer Performance with Vertical guidance
MF	Multi Frequency
MoC	Memorandum of Cooperation
MONA	Monitoring Aids
MoU	Memorandum of Understanding
MSAW	Minimum Safe Altitude Warning
MTCD	Medium Term Conflict Detection
NDB	Non-Directional Beacon
NM	Network Manager
NOP	Network Operations Plan
NOTAM	Notification to Air Man
NSA	National Supervisory Authority
OAT	Operational Air Traffic
OFA	Operational Focus Area
OI	Operational Improvement
OLDI	On-Line Data Interchange
OTMV	Occupancy Traffic Monitoring Values
OSs	Operational Stakeholders
PBN	Performance Based Navigation
PCP	Pilot Common Project
PEB	PENS Executive Board
PENS	Pan European Network Service
PKI	Public Key Infrastructure
PMU	PENS Management Unit
PSSG	PENS Steering Group
RA	Registration Authority

Acronym	Meaning
RIMS	Runway Incursion Monitoring System
RNP	Required Navigation Performance
RVR	Runway Visual Range
SBAS	Satellite Based Augmentation System
S/E rating	System/Equipment rating
SCP	Stakeholder Consultation Platform
SDD	Service Design Document
SDP	Static Data Procedures
SDP	SESAR Deployment Programme
SESAR	Single European Sky ATM Research
SID	Standard Instrument Departure
SOPS	Standard Operation Procedures
STAM	Short Term ATFCM Measures
STAR	Standard Arrival Routes
STCA	Short Term Conflict Alert
STDA	Short-Term Deployment Approach
SWIM	System Wide Information Management
SYSCO	System Supported Coordination
TBS	Time Based Separation
TCT	Tactical Controller Tool
TI	Technical Infrastructure
TMA	Terminal Manoeuvring Area
TMB	Top Management Body
TSAT	Target Start Up Approval Time
TTG	Time To Gain
TTL	Time To Lose
TTOT	Target Take Off Time
UUP	Updated Airspace Use Plan
VA	Validation Authority
VAMC	Volcanic Ash Mass Conditions
VDL	VHF Data Link
VGS	VHF Ground Station
VLD	VHF Digital Link
VNAV	Vertical Navigation
VoIP	Voice over IP
VOR	VHF Omnidirectional Range
WOC	Wing Operations Center
WXXM	Weather Information Exchange Model

6. Notes