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accompanying the

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Single European Sky II: towards more sustainable and better performing aviation

The SESAR Master plan for the development and implementation of the new generation European air traffic management system (SESAR - Single European Sky ATM Research)

{COM(2008) 389 final}

COMMISSION STAFF WORKING DOCUMENT

The SESAR Master plan for the development and implementation of the new generation European air traffic management system (SESAR - Single European Sky ATM Research)

1. INTRODUCTION

SESAR is a three phase project, launched in 2004, with the aim to **define**, **develop** and **deploy** a new generation and fully harmonised air traffic management (ATM) system in Europe. The definition phase has achieved to bring together the stakeholders in European aviation to build and commonly agree on a new ATM concept and a master plan establishing the research, development and deployment roadmap for its implementation. This result is summarised in the **SESAR Master plan** (Deliverable D5 of the definition phase annexed to this working document). The delivery of the SESAR Master plan and its presentation to the stakeholders' forum in Rome on 6.05.2008 has marked the end of the definition phase and triggered the start of the development phase which shall be managed by the SESAR Joint Undertaking[1].

The Commission services will perform a detailed assessment of the SESAR Master plan with a view to preparing the Commission proposal for a **European ATM Master plan** which is provided for in Article 1(2) of Council Regulation (EC) No 219/2007 establishing the SESAR Joint Undertaking. If endorsed by the Council, the proposed European ATM Master plan will then be transmitted for adoption to the SESAR Joint Undertaking and shall serve as basis for its work programme.

The European ATM Master plan is also a key element for the implementation of the Single European Sky (SES). It will in fact accelerate the required technological evolution of the present ATM systems which is the subject of the "third pillar" of the second stage of the Single European Sky. In fact, it forms part of the overall package of measures to revise the Single Sky which includes:

– amendments to the Single Sky Regulations;

– an extension of the competence of European Aviation Safety Authority to include ATM and airports in order to ensure a single approach to safety, as recommended by the High Level Group for the future European aviation Regulatory framework[2];

– developing the capacity and effectiveness of the airport system as set out in the Airport Action Plan and including an Airport Observatory[3].

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[1] Council Regulation (EC) 219/2007 of 27.02.2007, OJ L64, 2.03.2007, p.1

[2] Report of the High Level Group for the future European Aviation Regulatory Framework (July 2007)

[3] An Action Plan for Airport Capacity, Efficiency and Safety in Europe – COM(2006)819 24/1/2007 Approved by the Council on 2/10/2007 (13161/07).

The overall package is set out in the Communication from the Commission COM(2008) 389, which describes the principles and actions required to move towards Stage II of the Single European Sky (SES II).

The purpose of this working document is to complete the above mentioned Communication on SES II with the SESAR Master plan resulting from the definition phase and to provide the Commission services' initial view on it.

2. THE EUROPEAN ATM MASTER PLAN

The SESAR definition phase was a project co-funded by the European Community under the Trans European Network Transport programme and Eurocontrol. Most of the work was performed by an industry consortium, composed of around 50 companies representing all Air Traffic Management stakeholders groups and including non European organisations.

The SESAR definition phase resulted in a series of deliverables, and in particular in the SESAR Master Plan, which defines a detailed roadmap for the development and implementation of new generation air traffic management systems in Europe.

The Commission services consider that this SESAR Master Plan provides a sound basis for the following phases of the SESAR programme and **should be viewed as an initial version of the European ATM Master Plan** referred to in Council Regulation 219/2007.

The industry consortium has, in particular, succeeded in finding a common vision of the future operational concept for 2020, and has defined a consistent and gradual roadmap to achieve this operational vision, including transitional aspects which are a key difficulty in air traffic.

However, there are a certain number of shortcomings in the current SESAR Master Plan, which will need to be further deepened in the course of the development phase of SESAR. For instance, the Commission services believe that SESAR should be more ambitious on environment and efficiency targets, and that these elements should be reviewed, in particular in the light of the new performance framework set up by the SES II package.

For this reason, **the Commission services consider that the European ATM Master Plan should be a rolling plan**, with a process for amendments and updates described below.

1. Amendments, complements, updates to the European ATM Master Plan will be identified either as part of the Single European Sky activities, in particular the new Performance review framework, or by the SESAR Joint Undertaking work (for instance, identification of “quick wins” which can be implemented rapidly).

2. Such changes to the European ATM Master Plan are then taken on board by Eurocontrol, which organises thorough and wide stakeholders’ consultations, using renewed consultation arrangements.

3. The Commission takes the result and submits it to its Single European Sky consultation bodies, including the Industry Consultation Body and the Single European Sky Committee.

4. The amended European ATM Master Plan is then submitted to the SESAR Joint Undertaking Administrative Board for approval, under rules defined by the Council Regulation (EC) n°219/2007 (In particular, these rules foresee that the Community's position on proposals for amending the Master plan are adopted through a comitology procedure involving the Single Sky Committee[4]).

5. The amended European ATM Master Plan is communicated to the Parliament.

3. MANAGEMENT OF THE SESAR INITIATIVE

The SESAR Master Plan shows a complex set of interdependent activities which need to be managed cautiously.

From the organisational and institutional point of view, the Commission services consider that the proposals made in the SES II package, for instance on the performance review framework, and also in the relationship with a renewed Eurocontrol, provide good solutions to manage in particular the implementation aspects of SESAR.

From the managerial point of view, the creation by the Council of the SESAR Joint Undertaking, which pools the resources of all relevant actors into the management of a single European programme, will considerably diminish the development risk.

Since the SES II proposes a new institutional organisation for European Air Traffic Management, it is too early to define in detail what would be the most appropriate arrangements for transition from the development to the deployment phase. However, it is foreseen that the new SES network manager function would have to play a key role in this transition, and could play a significant role in coordinating the deployment of the new SESAR technologies. As announced in the Communication COM(2008)XXX on SES II, the Commission will prepare a more detailed Communication on this subject at a more mature stage of the project.

[4] Article 5 of Regulation (EC) no 549/2004, OJ L96, 31.03.2004, p.1.

ANNEX A – SESAR Master Plan

Deliverable 5 (D5) DLM-0710-001-02-00

Issued by the SESAR Consortium for the SESAR Definition Phase Project co-funded by the European Commission and EUROCONTROL

SESAR Ex Com
21st Decision Note – Ref: MGT-0803-001-01-00

We, Representatives of the Global Consortium Members within the SESAR Executive Committee, hereby approve the following D5 document for submission to the Purchaser ("EUROCONTROL") by the Project Directorate:

Document D5

Document No: DLM-0710-001-02-00 (accepted document)

Document Title: SESAR Master Plan

Brussels, April 2008

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Preface

The SESAR programme is the European Air Traffic Management (EATM) modernisation programme. It will combine technological, economic and regulatory aspects and will use the

Single European Sky (SES) legislation to synchronise the plans and actions of the different stakeholders and bring together resources for the development and implementation of the required improvements throughout Europe, in both airborne and ground systems.

The first phase of SESAR, the Definition Phase, is co-funded by EUROCONTROL and the European Commission under Trans European networks. The products of this Definition Phase are the result of a 2-year study awarded to an industry wide consortium supplemented by EUROCONTROL's expertise. It has delivered the SESAR Master Plan covering the period up to 2020 and the accompanying Programme of Work for the first 6 years of the subsequent Development Phase.

The SESAR Definition Phase has produced 6 main Milestone Deliverables (DLM) over the 2 years covering all aspects of the future European ATM System, including its supporting institutional framework. The scope of the 6 Deliverables (Dx) are:

D1: Air Transport Framework – the current situation;

D2: Air Transport Framework – the Performance Target;

D3: Definition of the future ATM Target Concept;

D4: Selection of the "Best" Deployment Scenario;

D5: Production of the SESAR Master Plan;

D6: Work Programme for 2008 –2013.

The SESAR Consortium has been selected to carry out the Definition Phase study, which for the first time in European ATM history has brought together the major stakeholders in European aviation to build the SESAR Master Plan. The SESAR Consortium draws upon the expertise of the major organisations within the aviation industry. This includes Airspace Users, Air Navigation Service Providers (ANS Providers), Airport Operators and the Supply Industry (European and non-European), plus a number of Associated Partners, including safety regulators, military organisations, staff associations (including pilots, controllers and engineers) and research centres who work together with the significant expertise of EUROCONTROL. This is considered to be a major achievement.

It must be noted that SESAR Definition Phase is a feasibility study, some long term results of which (e.g. the technology platforms) should be further validated and consolidated during the next SESAR phases before Stakeholders could effectively implement its outcome in a concrete way.

This fifth Deliverable, D5, has been produced in accordance with its Milestone Objective Plan (MOP) [Ref 1] with inputs from the seven Task deliverables which are providing the substantiating information and which are identified within the SESAR Work Breakdown Structure. D5 has subsequently been approved and accepted by all Project Participants.

The SESAR Consortium members:

AEA (Association of European Airlines), ADP (Aéroports de Paris), AENA (Aeropuertos Espanoles y Navegacion Aérea), AIRBUS, Air France, Air Traffic Alliance E.I.G/G.I.E, Amsterdam Airport SCHIPHOL, Austro Control GmbH, BAA Ltd, BAE Systems, DFS

Deutsche Flugsicherung GmbH, Deutsche Lufthansa AG, DSNA (Direction des Services de la Navigation Aérienne), EADS (European Aeronautic and Space Company), ENAV S.p.A. (Società Italiana per l'Assistenza al Volo), ERA (European Regions Airline Association), FRAPORT, IAOPA (International Council of Aircraft Owner and Pilot Associations), IATA (International Air Transport Association), Iberia, INDRA Sistemas SA, KLM (KLM Royal Dutch Airlines), LFV (Luftfartsverket), LVNL (Luchtverkeer Nederland), Munich International Airport, NATS (National Air Traffic Services), Navegaçao Aérea de Portugal (NAV), SELEX Sistemi Integrati, THALES Air Systems S.A., THALES AVIONICS.

The SESAR Associated Partners:

ATC EUC (Air Traffic Controllers European Unions Coordination), Boeing, CAA UK (Civil Aviation Authority UK), ECA (European Cockpit Association), ELFAA (European Low Fare Airlines Association), ETF (European Transport Workers' Federation), EURAMID (European ATM Military Directors), IFATCA (International Federation of Air Traffic Controllers' Associations), IFATSEA (International Federation of Air Traffic Safety Electronics Association), Honeywell, Rockwell-Collins, Dassault Aviation (representing EBAA). Research Centres: AENA (Aeropuertos Espanoles y Navegacion Aérea), DFS Deutsche Flugsicherung GmbH, DLR (Deutsches Zentrum für Luft – und Raumfahrt), DSNA (Direction des Services de la Navigation Aérienne), INECO (Ingenieria y Economia del Transporte, S.A.), ISDEFE (Ingenieria de Sistemas para la Defensa de Espana), NLR (Stichting Nationaal Lucht- en Ruimtevaartlaboratorium), SICTA (Sistemi Innovativi per il Controllo del Traffico Aereo), SOFREAVIA (Société Française d'Etudes et de Réalisations d'Equipments Aéronautiques).

Executive Summary

The SESAR Master Plan is coordinating the ATM future of Europe

The content of this SESAR Master Plan (further referred to as the Master Plan) builds upon the material contained in Deliverables D1, D2, D3 and D4 to provide a plan for implementing the ATM Target Concept addressing deployment and R&D planning in terms of roadmaps for Operational Evolutions, Enabler Development & Deployment and Supporting Aspects. These roadmaps encompass the lifecycle between feasibility up to and including deployment and are supported by an analysis of the associated Benefits, Funding and Financing aspects as well as the related risks. Both the time component of the roadmaps and the associated benefits are critical for the success of the future phases of the SESAR programme. It is important that the core components of the ATM Target Concept are implemented timely and consistently at European network level to enjoy their full benefits. It is recommended that this timely implementation will be supported by innovative incentive and/or penalty mechanisms to provide the best opportunity cost for all stakeholders to quickly adopt the system.

Structure of the Master Plan - from agreed High Level View to Committed Action

D5 represents the High Level Overview of the Master Plan. It is the agreed strategic guideline delivered by the SESAR Consortium. It identifies necessary activities on a stakeholder group level.

This High Level Overview is accompanied by working material, which contains more detailed information. The working material comprises the Task Deliverables of the SESAR Consortium and the Master Plan Database which is being migrated into the electronic Master

Plan, the electronic Master Plan portal which can be found at the following web address: www.atmmasterplan.eu.

This working material serves as a "Planning Area" from which specific R&D and individual implementation activities will be derived and agreed. Once agreed and committed implementation activities will be captured and monitored through a renewed ECIP/LCIP process. The ECIP planning material provides the third element of the Master Plan.

All three elements of the Master Plan, the "High Level View" (D5), the "Planning Area" and the "Agreed and Committed Implementation Activities" (renewed ECIP/LCIP process) provide the necessary set of planning means to ensure the successful implementation of the ATM Target Concept.

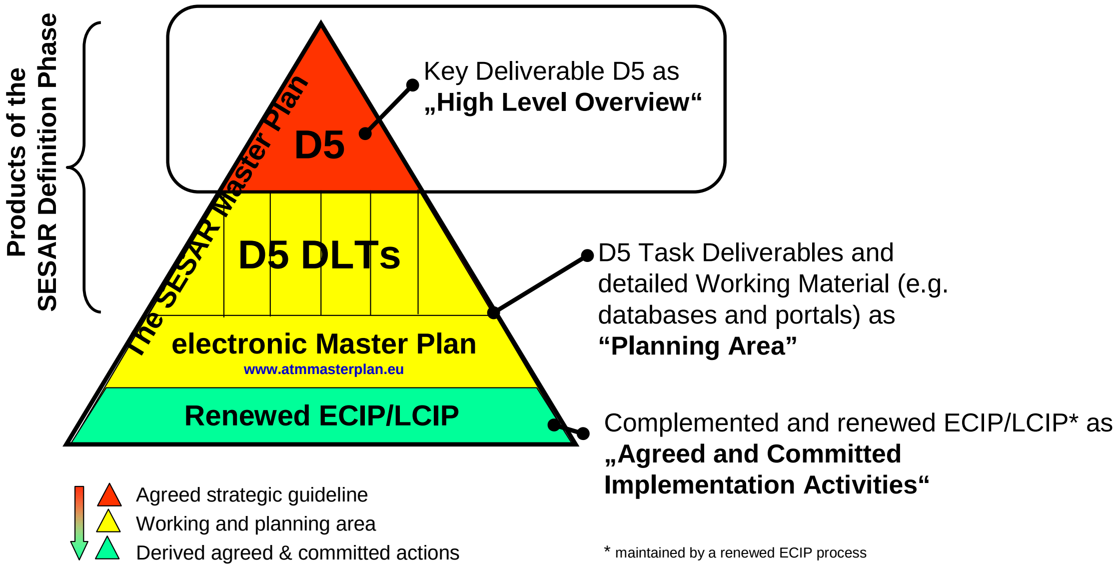


Figure 1 Structure of the Master Plan

The ATM Target Concept – from validation to implementation

The ATM Target Concept describes the main areas and directions of progress to be made. The specific and detailed changes (called "operational improvements [OI] steps)") required to transition from today's system have been structured in a series of ATM Service Levels (0-5)[5] and organized in Implementation Packages 1-3 depending upon the date at which the corresponding capability can become operational (Initial Operational Capability (IOC) date):

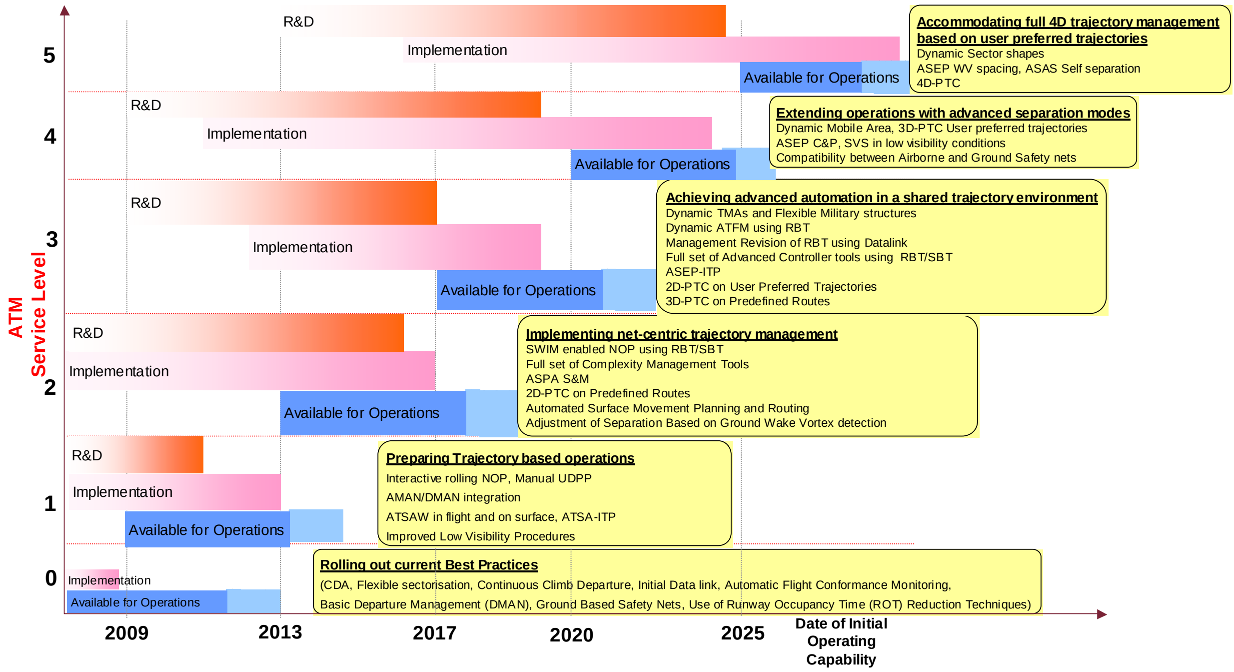
- IP1 – Implementation Package 1 (short-term: IOC dates up to 2012)
    - Covers ATM Service Levels 0 and 1
- IP2 – Implementation Package 2 (medium term: IOC dates in the period 2013-2019)

[5] The notion of ATM capability levels had already been introduced in D3. Please note that the definition of some levels has been changed in D5.

– Covers ATM Service Levels 2 and 3

- IP3 – Implementation Package 3 (long term: IOC dates from 2020 onwards)

  – Covers ATM Service Level 4 and 5.



Note: Long R&D and implementation durations are the result of combining many data but do not reflect the time needed to introduce a specific improvement at a specific location.

Figure 2 Master Plan Overview

The R&D and deployment activities fit in the context of a wider lifecycle based approach. For master planning purposes, a standard decomposition of the ATM lifecycle has been adopted. Road maps show the R&D and deployment activities as foreseen in the current version of the plan:

How and by when the ATM Service Level of the European ATM system needs to be enhanced to respond to evolving performance needs while transitioning to the ATM Target Concept. This is presented in the Operational Evolution Roadmaps showing per Service Level the changes for each line of change.

The deployment plan for the evolution towards System Wide Information Management (SWIM).

What and by when Stakeholders have to deploy to realise a Capability Level enabling a Service Level. This is presented in the Stakeholder Deployment Plans, which also include the lifecycle for R&D, and deployment.

Which and by when supporting and enabling improvements need to be implemented.

Benefits and Financing

The total investment for the implementation of the 2020 ATM System covering all stakeholder groups amounts to approx. €30Bn.

The Cost Benefit Analysis results are based on the following important assumptions; timely and synchronised implementation of the complementary and efficient ground ATM services and tools exploiting the airborne investments; and that ANS Providers/Airport Operators deliver the projected Quality of Service and unit cost reductions.

For scheduled airlines the CBA is positive although for the service level 3 deployment phase the initial investment is high and the payback period is long.

With the current avionics cost estimates, analyses so far indicate that CBAs for BA & GA will likely be negative. Further work is required, especially to define suitable and more affordable enablers tailored to the BA and GA needs.

For the Military, the CBA computations started during SESAR Definition Phase have to be pursued with a better estimation of their benefits in their role as User, ANS provider and Airport operator.

Improved staff productivity remains the main driver to achieve reduction of ANS provision unit cost. This is achieved by introducing operational improvements to increase the ATCO productivity. This will allow to depart from the traditional way of adding sectors and associated staff when traffic increases. The investments to improve the performance of the system are mainly for the provision of better information to the controller and the introduction of advanced automation tools.

Additional initiatives, external to the scope of the SESAR Programme but within the framework of the Single European Sky, would have to deliver a unit cost reduction of €230/flight in order to achieve the Cost Effectiveness target of €400/flight. These initiatives will benefit from the technical ability of the ATM Target Concept to support FAB implementation and technical de-fragmentation. In addition, the exploitation of synergies between ANS Providers and the co-ordination of initiatives at European level (e.g. elimination of redundant CNS aids, generic validations) are facilitated as well. However, the potential effects of these initiatives have not been assessed by the SESAR Consortium since they are outside the scope of SESAR.

An economic scheme needs to be established which addresses the relationship between the required investments for all stakeholders and the commitment to achieve cost-effectiveness and quality of service targets from ANS Providers and Airport Operators. The collaboration in synchronous investment planning and measurement / evaluation of costs and benefits is therefore essential.

Risks

The following high priority risks have been identified for the future of the Master Plan and therefore the SESAR programme as a whole:

– Non homogeneous deployment across Europe of ATM Service Level 0 and 1 initiatives;

– Governance Structure is not capable of ensuring successful deployment of ATM Service Levels 2 to 5;

– Future investment in SESAR by key Stakeholders will not be secured;

– Future work on the ATM Target Concept exposes shortcomings in meeting design and performance targets;

– Delays to the availability of new technologies to support the ATM Target Concept;

– SWIM is not implemented in its correct form or sufficiently early.

– Regulatory Framework is unable to support the implementation of the ATM Target Concept;

– Performance based approach not implemented;

– Failure to manage human resources, human performance, social factors and change management;

– No agreement on future de-fragmentation of European airspace.

SESAR is ready for the Development Phase and implementation

The Master Plan will guide the future of ATM in Europe over the next decades and forms the basis for the programme of work for the first part of the SESAR implementation phase. It will become a "rolling" plan that will be regularly updated in accordance with the results from the R&D activities starting under the responsibility of the SESAR JU. Continuous performance monitoring will need to be undertaken to ensure that the future ATM activities will be conducted to deliver the agreed benefits defined within an agreed performance framework. All major stakeholders in Europe have come together to agree upon this rational step forward to achieve the performance driven ATM system in Europe.

This Master Plan will be handed over to the SESAR JU, which is responsible for its execution and updates for the coming years. At this stage all stakeholders in Europe are asked to adopt this Master Plan including their commitment to the implementation of IP1 and to the R&D plan in support of IP2 and IP3. All stakeholders will be requested to analyse the Master Plan in respect of their country/organisations criticality and implement the actions in the timeframe required.

The focus for all stakeholders should be (1) on timely deployment of the short-term solutions bringing early benefits, and (2) on the R&D activities of the SESAR JU that shall allow for (a) timely deployment of the 2020 System and (b) consolidation of the final roadmap for the implementation of the ATM Target Concept.

Proactive management and anticipation of the future will support the successful implementation, which at one point will be supported by economic regulation. Political support is needed not only for SESAR but also regarding further cooperation, alliances or mergers of Air Navigation Service provision by the FAB initiative, together with additional measures envisaged by SES Package II. Further work is urgently required to reach the cost-effectiveness target.

The SESAR Consortium, and associated partners have agreed on the SESAR Master Plan (D5) representing the fundamental coordination tool for all future ATM activities. The

Implementation of the Master Plan together with the SESII package will lead to a better performing ATM system in Europe.

Key requirements for the SESAR future

The objective of the Master Plan is to meet the performance targets and to deliver the expected benefits to the ATM stakeholders. The following **seven key requirements have been identified as critical for the successful implementation of the Master Plan:**

1. Establishing a **single European Legislative Framework:** The rationalisation and alignment of European and national regulations is essential for the full implementation of the Single European Sky. However, regulation should only be used where necessary in accordance with "better regulation" principles to reach agreements and to support enforcement of commitments across the diversity of Member States and stakeholder interests;

2. A **performance-driven approach:** The SESAR performance framework builds on ICAO guidance material and existing processes to develop a European-wide system for setting, agreeing, and maintaining performance targets. This needs to be established within the regulatory framework as anticipated by the European Commission to reach the required improvements in safety, efficiency, capacity, environmental sustainability and cost-effectiveness. The whole approach needs to be supported by a comprehensive monitoring and reporting system;

3. Clear **ownership and endorsement of the Master Plan** at all levels, political, regulatory, and industry. In consequence, this will require transparency and alignment of the operating and investment plans of all stakeholders, in particular, NSAs, ANS Providers, airspace users (including the military), airports and third party suppliers (supply industry, aircraft manufacturers, etc.);

4. Definition of **clear governance and leadership structure for the deployment** activities covering all phases is vital.

This coordination should be realised (a) through the implementation of the deployment programmes, which need to be agreed, (b) through strengthening stakeholder engagement and influence in appropriate forums, e.g. a future ATM Performance Partnership as part of the business framework and specifically for Implementation Package 1 (c) through the re-enforcement of a renewed ECIP/LCIP process to cover the SES monitoring requirements.

1. The establishment of a **single system design function**: Having established an European ATM Enterprise Architecture to facilitate the ATM performance partnership, a single system design function needs to be formed as referenced in SESAR Deliverable D1 for the design of the technical architecture of the future ATM System.

2. To ensure **interoperability of SESAR results** at regional and global level, it is necessary to link the system design activities with the existing standardisation processes (EUROCAE, RTCA, etc.) including the military and the respective regulatory structures (SES, ICAO, etc.).

3. Industry must be able to **balance cost and benefits**. The long lead times in some areas of the Master Plan may need measures to guarantee proper funding, where

necessary through incentives, to keep to the schedule for investing in the deployment of the SESAR target solutions and decommissioning legacy systems.

TABLE OF CONTENTS

1. Introduction

1.1. Purpose and Scope

1.1.1. D5 and the Master Plan

D5 represents the High Level Overview of the SESAR Master Plan (further referred to as the Master Plan). It is the agreed strategic guideline delivered by the SESAR Consortium. It identifies necessary activities on a Stakeholder Group level.

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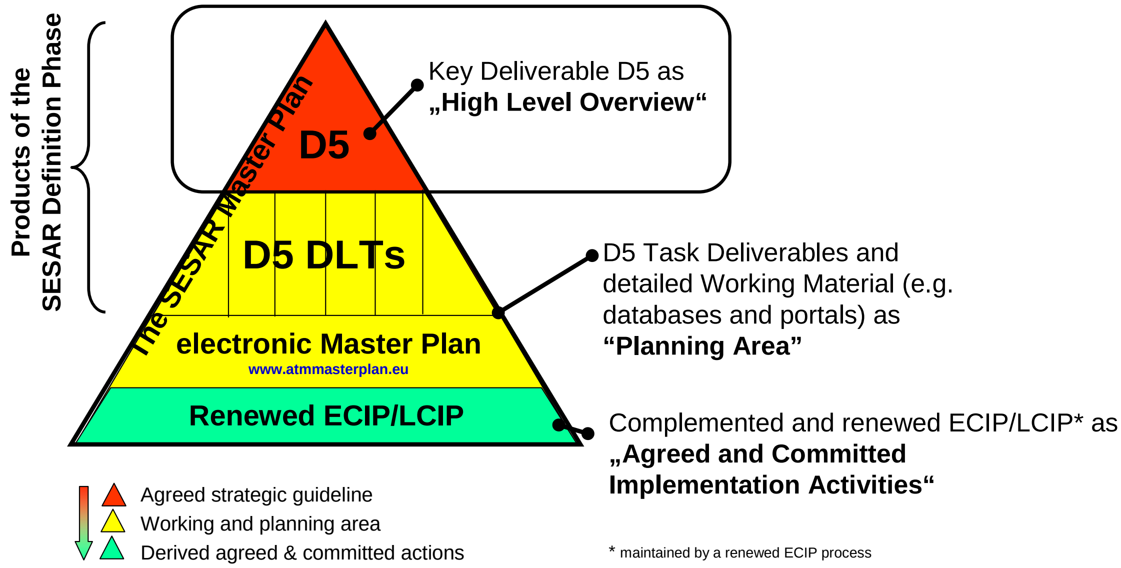

Figure 3 Structure of the Master Plan

All three elements of the Master Plan, the "High Level View" (D5), the "Planning Area" and the "Agreed and Committed Implementation Activities" (renewed ECIP/LCIP process) provide the necessary set of planning means to ensure the successful implementation of the SESAR ATM Target Concept.

The Master Plan will become a “rolling” plan that will be regularly updated, while continuous performance monitoring will be undertaken to ensure that the future ATM activities will deliver the agreed benefits defined within an agreed performance framework. This Master

Plan will be handed over to the SESAR JU who is responsible for its execution and updates for the coming years.

1.1.2. Relationship with D4

D5 has built on the previous SESAR deliverables, in particular D4, which has described how the Deployment Sequence would realise the ATM Target Concept [Ref. 4]. A summary of the results and findings of the previous SESAR Milestone Deliverables D1-D4 can be found in Annex **Error! Reference source not found.**.

D5 has further refined the D4 deployment sequence by splitting each of the three Implementation Packages (IP) into two ATM Capability Levels (ACL) with associated ATM Service Levels (ASL). This extra granularity was needed to slice the deployment sequence into smaller chunks, which better match the needs of the “rolling” Master Plan update process.

D5 turns the D4 deployment sequence into the Master Plan by proposing an initial set of dates for the lifecycle timing of all development activities that precede the operational introduction of the system enhancements and operational improvements foreseen in the deployment roadmaps. In particular, this Master Plan defines for each topic: when R&D should start, by which target date it has to be completed, and following this how much time is foreseen for initial implementation, in order to achieve agreed target dates for Initial Operational Capability (IOC) in Europe. These IOC dates have been chosen in D4 with the objective of striking a balance between, on one hand, the future performance needs of the most challenging operational environments in Europe, and on the other hand the complexity and present maturity of the individual topics which will be subject to R&D and implementation. The information used to establish these critical dates (e.g. for R&D, IOC, etc.) is based on expert judgement.

1.1.3. Relationship with ICAO Planning Documents

This Master Plan document considers the Global Air Navigation Plan for Communication Navigation Surveillance/Air Traffic Management (CNS/ATM) Systems (Global Plan, Doc 9750), which was developed by ICAO as a strategic document to provide reference for the implementation of CNS/ATM systems.

The Global Plan supports global Interoperability and contains near and medium term guidance on air navigation system improvements necessary to support a uniform transition to the ATM system envisioned in the Global ATM Operational Concept (Doc 9854).

In accordance with the Global Plan, planning should be focused on specific performance objectives, supported by a set of “Global Plan Initiatives”. These initiatives are options for air navigation system improvements that when implemented, result in direct performance enhancements. States and regions will choose initiatives that meet performance objectives, identified through an analytical process, specific to the particular needs of a State, region, homogeneous ATM area or major traffic flow. The terminology and methodology used in this document are consistent with ICAO use.

1.2. Document organisation

This document is organised as follows:

Chapter 1 provides a brief introduction to the purpose and scope of the D5 document.

Chapters 2 to 5 contain planning information (including benefit, financing and risk aspects), which is essentially time-based. This is schematically illustrated in Figure 4.

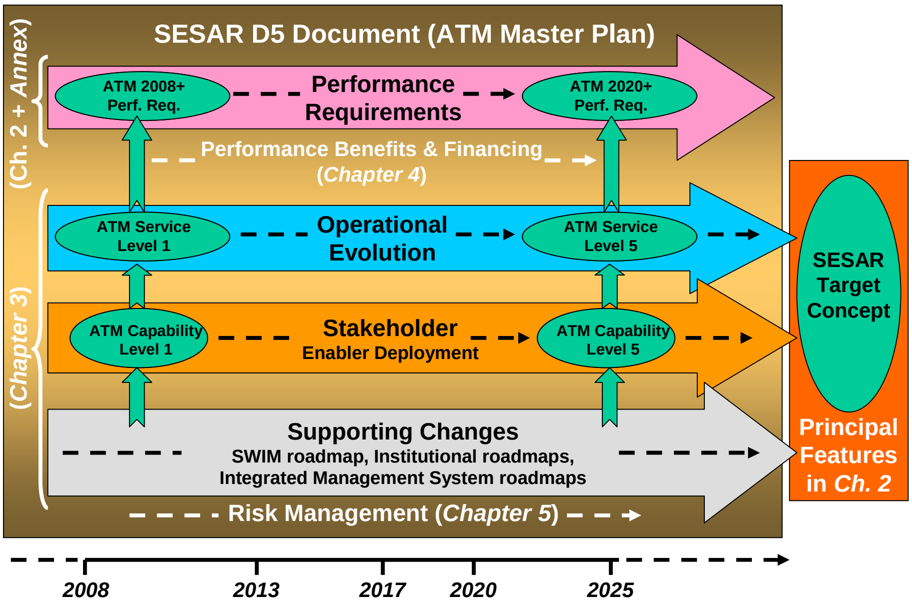

Figure 4 Contents of the D5 Document

Chapter 2 describes the principles used to build the Master Plan and introduces the way in which it should be managed in the future.

Chapter 3 contains the heart of the Plan. It contains three sections: (1) the roadmaps for operational evolutions, (2) supporting changes like the evolution towards System Wide Information Management (SWIM), the institutional roadmaps, and the Integrated Management System roadmaps; and (3) the stakeholder deployment plans for ATM systems and infrastructures. For each of these it identifies in detail the deployment actions which must be taken to implement the ATM Target Concept, combining these with the detailed planning of the research and development work, which is needed to consolidate them.

Chapter Error! Reference source not found. describes the benefits, the investments and the financial aspects associated to the Master Plan for the implementation of the ATM Target Concept. An evolutionary approach to meeting the performance targets and optimising the benefits has been taken in order to secure the financial viability of the Plan. Whilst the focus of the benefits planning to 2020 has been in the KPAs of cost effectiveness and capacity, including the quality of services, benefits are anticipated in all KPAs.

Chapter Error! Reference source not found. provides an outline of the high priority risks and associated mitigation actions for the implementation the Master Plan. The material contained in this Chapter has been analysed and built upon the major solution risks, which were identified and tracked throughout the production of the SESAR Deliverables D1 to D4. They should be the basis of the programme of work to be defined in the SESAR Deliverable D6 and undertaken by the SESAR JU. They are considered to be the high risk aspects of achieving the Master Plan and hence, those aspects which should be worked on, as a matter of urgency, from the very start of the SESAR Development Phase.

2. Building the Master Plan

This chapter describes the principles used to build the Master Plan and introduces the way in which it should be managed in the future.

2.1. Performance-Based Approach

ICAO defines the Performance Based Approach [Ref 14] as being based on the following three principles:

– Strong focus on desired/required results;

– Informed decision making, driven by the desired/required results;

– Reliance on facts and data for decision-making.

The initial activities to make the transition to taking such an approach have been carried out. D2 set performance expectations which the ATM industry should deliver and established a SESAR performance framework based upon the 11 ICAO KPAs, setting performance objectives for each of them, with associated indicators and targets. In response to the performance objectives and targets, D3 has defined the Target Concept and D4 has outlined the overall deployment sequence for implementing it; the sequence being expressed in terms of operational improvement (OI) steps and associated enablers.

2.1.1. Performance Framework

In November 2005, during the public announcement of the SESAR Definition Phase contract, EC Vice-President Jacques Barrot expressed the EC objectives of the SESAR programme, which are to achieve a future European Air Traffic Management (ATM) System for 2020 and beyond which can, relative to today's performance:

- Enable a 3-fold increase in capacity which will also reduce delays, both on the ground and in the air;
- Improve the safety performance by a factor of 10;
- Enable a 10% reduction in the effects flights have on the environment and
- Provide ATM services at a cost to the airspace users which is at least 50% less.

These statements constitute the political vision and goals for the design of the future ATM System. These vision and goals have been analysed by reference to the 2020 demand and has resulted into specific initial targets for that particular year, notwithstanding the subsequent evolutions necessary to meet the growing demand.

This performance framework has been clarified and refined as a result of D3 and D4 activities. It shall be noted that the ATM System will further evolve after 2020 in order to sufficiently address the political design goals. D2 has to be read in conjunction with the material contained in the SESAR Definition Phase report "Performance Objectives and Targets" [Ref 13]. The SESAR Performance Framework is summarised in Annex **Error! Reference source not found.**, with an overview of the Key Performance Indicators (KPI) for which targets have been agreed as described in Table 1 below.

Table 1 Summary of the 2020 Performance Targets

KAP	Key Performance Indicator (KPI)	Baseline		2020 Target	
		Year	Value	Absolute	Relative
Capacity	Annual IFR flights in Europe	2005	9.2 M	16 M	+ 73%
	Daily IFR flights in Europe	2005	29,000	50,000	+ 73%
	Best In Class (BIC) declared airport capacity in VMC (1 RWY), mov/hr	2008	50	60	+20%
	BIC declared airport capacity in VMC (2 parallel dependent RWYs), mov/hr	2008	90	90	+0%
	BIC declared airport capacity in VMC (2 parallel independent RWYs), mov/hr	2008	90	120	+25%
	BIC declared airport capacity in IMC (1 RWY), mov/hr	2008	25	48	+90%
	BIC declared airport capacity in IMC (2 parallel dependent RWYs), mov/hr	2008	45	72	+60%
	BIC declared airport capacity in IMC (2 parallel independent RWYs), mov/hr	2008	45	96	+110%
Cost Effectiveness	Total annual en-route and terminal ANS cost in Europe, €/flight	2004	800	400	-50%
Efficiency	Scheduled flights departing on time (as planned)			>98%	
	Avg delay of the remaining scheduled flights			<10 min	
	Flights with block-to-block time as planned			>95%	
	Avg. block-to-block time extension of the remaining flights			<10 min	
	Flights with fuel consumption as planned			>95%	

	Avg. additional fuel consumption of the remaining flights			<5%	

Flexibility	Accommodation of VFR-IFR change requests			>98%	
	Unscheduled flights departing on time (as requested)			>98%	
	Avg delay of the remaining unscheduled flights			<5 min	
	Scheduled flights with departure time as requested (after change request)			>98%	
	Avg delay of the remaining scheduled flights			<5 min	
Predictability	Coefficient of variation for actual block-to-block times: for repeatedly flown routes			<1.5%	
	Flights arriving on time (as planned)			>95%	
	Avg arrival delay of the remaining flights			<10 min	
	Total reactionary delay	2010			-50%
	Reactionary flight cancellation rate	2010			-50%
	Total service disruption delay	2010			-50%
	Percentage of diversions caused by service disruption	2010			-50%
Safety	Annual European-wide absolute number of ATM induced accidents and serious or risk bearing incidents	2005		No increase	
	Safety level (per flight)	2005			x 3
Environmental Sustainability	Avg. fuel savings per flight as a result of ATM improvements	2005			10%
	Avg. CO_2 emission per flight as a result of ATM improvements	2005			-10%
	Compliance with local environmental rules			100%	

	Number of proposed environmentally related ATM constraints subjected to a transparent assessment with an environment and socio-economic scope			100%	

D2 concluded with the following particular recommendations:

- Distinct business & regulatory management frameworks be created which work to a common performance framework based upon that developed by ICAO (International Civil Aviation Organisation), and which have a "dynamic working relationship" between them to ensure the best outcome is achieved for the ATM industry as a whole;

- The ICAO global ATM operational concept [Ref 5] be used as the reference for the development of the ATM system;

- Stakeholders have to establish an ATM Performance Partnership (ATMPP).

2.1.2. Concept of Operations

Using D1 and D2 as the basis, the Concept of Operations was developed in D3. Its principle features are:

- Trajectory Management that is introducing a new approach to airspace design and management;

- Collaborative planning continuously reflected in the Network Operations Plan (NOP);

- Integrated Airport operations contributing to capacity gains;

- New separation modes to allow for increased safety, capacity, and efficiency;

- An increased reliance of airborne and ground based automated support tools;

- System Wide Information Management (SWIM) integrating and properly disseminating all ATM business related data;

- Humans who will be central in the future European ATM system while their role is evolving to managing and decision-making.

More detailed information is available in [Ref 17].

2.2. ATM Performance Partnership

To support the ATM management process, D2 has identified the need for Business Management & Regulatory Management frameworks which both work to a common performance framework (see section 2.1.1).

The Business Management framework should be established by an ATM Performance Partnership, this being composed of the: i.e. Civil Airspace Users (both Commercial and Non-Commercial), Military, ANS Providers, Airports, Supply Industry (for their design part), EUROCONTROL (for their pan-European and regional functions) and Social Partners. In order to:

- Reconcile the different partners' business and/or mission objectives;
- Identify those aspects of their visions which are common in terms of creating and managing the future ATM System;
- Defining how the partners should interact to create and manage the future System.

This yet-to-be established ATM Performance Partnership is intended to be based on the principles of a European ATM Enterprise Architecture (EAEA).

2.2.1. European ATM Enterprise Architecture

European ATM should be considered as a virtual single enterprise in which the constituent parts work together in a networked (net-centric), service-based operation with the business processes driving the services (including IT). The concept of this virtual single enterprise is instantiated in the European ATM Enterprise Architecture (EAEA).

It encompasses the structure and behaviour of the virtual single enterprise's ATM related processes, functions, information systems, personnel and organizational sub-units aligned with the performance partnership's goals and strategic direction as defined by the Master Plan.

Having established an European ATM Enterprise Architecture to facilitate the ATM performance partnership, a single system design function needs to be formed as referenced in SESAR Deliverable D1 for the design of the technical architecture of the future ATM System. The role of this function is to be accountable for the System's overall design, in particular defining the high level ATM System requirements needed to meet future business needs and ensuring the coherent integration of air and ground systems throughout the whole System. The initial design of the ATM System and its subsequent changes are approved through the decision making process. This system design function supports this process by providing design knowledge and expertise to ensure the full scope of the changes to be made have been identified and providing assurance that the System will perform as required.

2.2.2. Service-Oriented Approach

To populate the EAEA, a Service-Oriented approach should be taken, it being the key enabler to allow aspects of the future ATM System to respond more quickly to rapidly changing business needs. Clearly, these need to be brought together in a coherent and consistent manner.

Here, in general, a service is defined as "the delivery of a capability in line with published characteristics (including policies)". The EAEA must clearly distinguish the ATM Services (also called Business services) that have to be provided from the underlying (technical) supporting services and the physical assets that will need to be deployed (also called Information Technology Services).

2.3. Structuring and Managing the Master Plan

2.3.1. ATM Service and Capability Levels

2.3.1.1. Principles

The notion of ATM Service Level and ATM Capability Level will be used as the top-level, System-wide basis to establish the performance characteristics with which all components (covering both those on-board aircraft and within the ground-based systems) of the future European ATM System will be linked.

SESAR has defined six levels, which will progressively be deployed as shown in Figure 5.

Capability levels are associated with Stakeholder **systems, procedures, human resources etc**. Upgrading a Stakeholder to a higher capability level means deployment of new enablers, and this requires investments (costs).

Service levels are associated with operational **services** offered by a service provider and consumed by a service user. Upgrading a service to a higher service level means deployment of operational improvement steps, and this leads to benefits (performance improvements).

Delivering a service at a given service level X requires that *both* the service provider and the service user have *at least* evolved to capability level X[6]. Backward compatibility is also required: each system, which has a given capability level, should also be able to provide and receive services at a lower service level[7]. This ensures interoperability between systems of different capability levels. For example:

- Aircraft at capability level 3 is flying into a capability level 2 airport. They will provide and use service level 2. The performance benefits are those associated with service level 2.

- Aircraft at capability level 1 is flying into a capability level 2 airport. They will provide and use service level 1. The performance benefits are those associated with service level 1.

Utilising a service requires that both the service provider and the service user possess the required capability, but not necessarily all the capabilities of a particular level.

In a mixed ATM environment it is clear that such capability mismatches will occur to some extent. However the general rule for deployment should be that air and ground deployment should be geographically synchronised as much as possible, to avoid ‘wasting’ capabilities.

The above relationships are illustrated in Figure 6.

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[6] The SWIM network will enable services to be provided using information from a variety of sources, for example, the flight operations centre is capable of providing trajectory data broadly equivalent to that obtained directly from an aircraft.

[7] Currently this capability does not exist; the service level is often only increased when compatible with the overwhelming majority of the traffic; to enable such a capability, the principles of Conops Section F1.1.1 (Ref 17) will need to be applied.

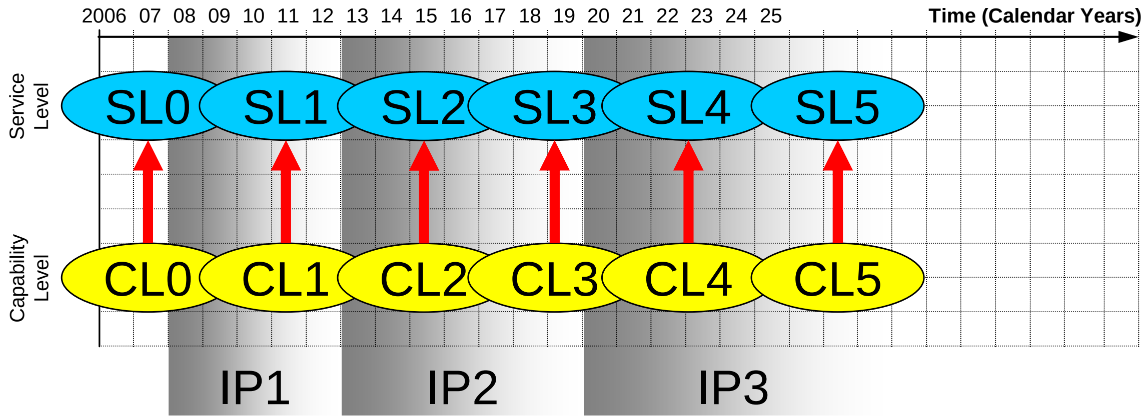


Figure 5 Deployment of ATM Service and Capability Levels

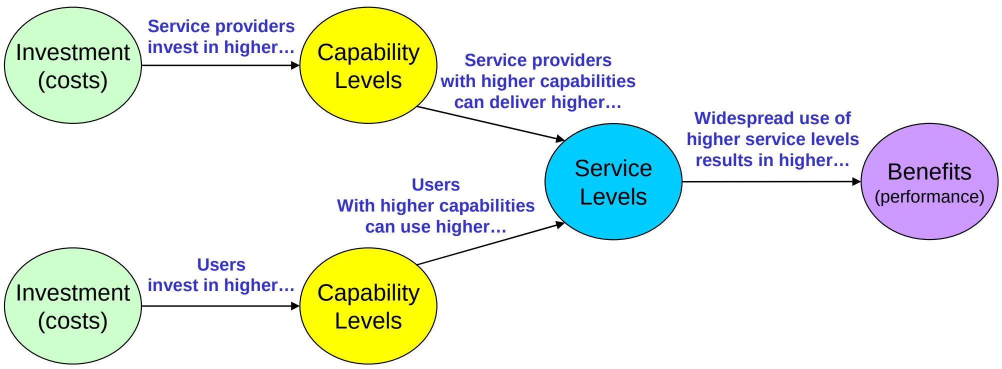


Figure 6 Relationship between ATM Service and Capability Levels

The notion of ATM Capability Levels had already been introduced in D3. Please note that the definition of some levels has been changed in D5:

- D5 Capability Level 3 did not exist in D3;
- D5 Capability Level 4 corresponds to D3 Capability Level 3;
- D5 Capability Level 5 corresponds to D3 Capability Level 4.

2.3.1.2. Role of ATM Service and Capability Levels in the Transition Scenario

The above principles will come to life as described in the following performance based transition scenario, which is also illustrated in Figure 7.

- **R&D and Industrialisation of Enablers.** The execution of the Master Plan will lead to timely availability of more advanced ATM systems, procedures, human resource enablers, standards, and supporting regulatory and legislative changes (collectively called enablers). For the sake of consistent and synchronised strategic planning, these have been grouped into ATM Capability Levels. Between today and 2020, Research, Development and Industrialisation is planned for rolling out Capability Levels 1 through 3, followed by the roll-out of levels 4 and 5 from 2020 onwards. The Master Plan also includes a Level 0, which corresponds to currently available systems and best practices for which deployment is already in progress, but not yet completed;

- **Deployment of Enablers.** As part of the Stakeholder Deployment Plan, aircraft, airports, and ATM facilities serving TMAs and en-route airspace will be progressively equipped by the Stakeholders with these new capabilities where needed. The number of less capable units will diminish over time due to the need to accommodate the increase in traffic over the whole network, but at any given moment, the European ATM System will comprise aircraft, airports and ATM facilities of a variety of ATM Capability Levels;

- **Introduction of new operational improvements.** Each new ATM Capability Level will introduce enablers designed to support operational improvements corresponding to a certain ATM Service Level;

- **Synchronised deployment of Enablers.** Generally speaking, in order to receive services at a given ATM Service Level, the aircraft as well as the Service Providers responsible for the area in which they are operating (airports, TMAs, Enroute airspace) must be at least equipped to the corresponding ATM Capability Level (Figure 7**);**

- **Benefits dependent on speed of deployment in a mixed environment.** More advanced ATM Service Levels are associated with higher performance and deliver more benefits. As shown in Figure 7, at any one time, traffic composed of aircraft with different levels of ATM capability will be operating at a variety of ATM Service Levels in the European ATM System. It is important to ensure timely managed and efficient transition to the higher ATM Service Levels, and reduce the use of less advanced levels, because the greater the number of flights operating at the higher service levels, the greater will be the performance benefits overall. It should be noted that this regime provides a basis upon which to build financial incentives to promote the timely managed and efficient transition to higher service levels through, for example, differential pricing for different ATM Service Levels. In other cases a mandate will be necessary to achieve the required speed of transition;

- **Transition strategy of individual Stakeholders.** As traffic demand grows, the plan is to ensure that “new” traffic makes use of the most advanced ATM Service Level, which is available at that moment. In addition, “old” traffic will also progressively migrate to more advanced Service Levels, albeit with some years delay. This will be the result of retrofitting/upgrading aircraft, flight operation centres, airports and ATM facilities with higher ATM Capability Levels. This does however not mean or require that every unit will upgrade level by level. In a number of cases, (USER/ANS Provider/Airport Operators) stakeholders may wish to keep the number of retrofits to a minimum and decide to skip a level (e.g. to migrate from level 1 immediately to level 3).

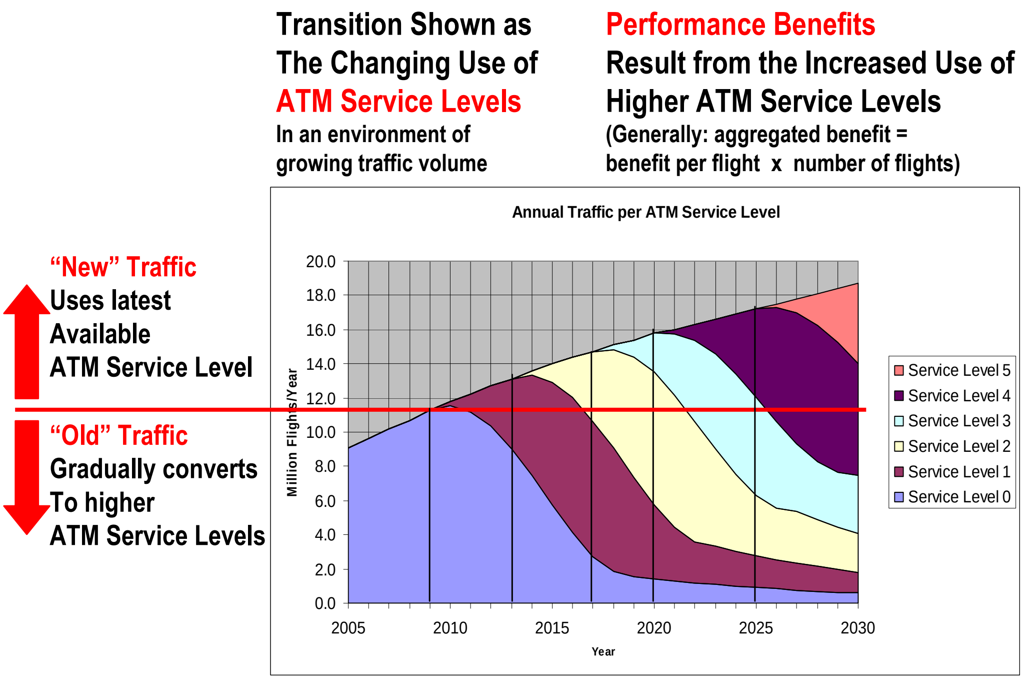


Figure 7 Principles for Performance Based Transition

2.3.1.3. Relationship with Implementation Packages

For the sake of situating the various ATM Service and ATM Capability Levels in time, the SESAR Implementation Phase has been subdivided into three time periods (called Implementation Packages in D4 [Ref 5]) which are linked to the Initial Operational Capability (IOC) dates of the ATM Service Levels as shown below and in Figure 5:

- IP1 – Implementation Package 1 (short-term: IOC dates up to 2012)
  - Covers ATM Service Levels 0 and 1;
- IP2 – Implementation Package 2 (medium term: IOC dates in the period 2013-2019)
  - Covers ATM Service Levels 2 and 3;
- IP3 – Implementation Package 3 (long term: IOC dates from 2020 onwards)
  - Covers ATM Service Levels 4 and 5.

2.3.1.4. Relationship with ECIP/LCIP

The current edition of ECIP/LCIP covers the period 2008-2012. It is clear from the above that its contents should correspond to the deployment of ATM Service and ATM Capability Levels 0 and 1.

2.3.2. <u>ATM Lifecycle Approach</u>

This section is a guide to understanding the *road maps* which are presented in Chapter 3.

Road maps show the R&D and Implementation *activities* as foreseen in the current version of the plan.

The activities planned for the 2008-2013 periods have been incorporated in the *Work Programme* that is presented in D6.

The R&D and Implementation activities fit in the context of a wider *lifecycle* based approach.

For master planning purposes, a standard decomposition of the ATM lifecycle has been adopted. The complete lifecycle is subdivided into eight phases[8] as shown in Figure 8.

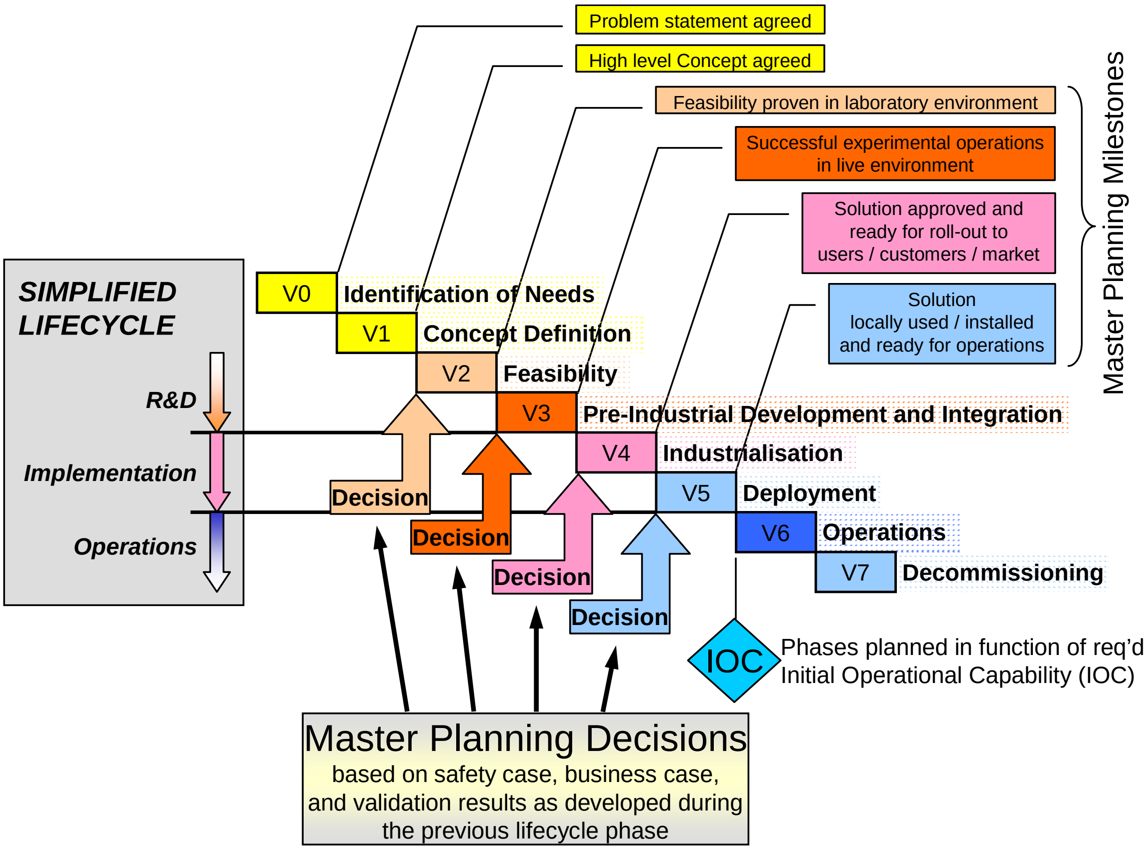


Figure 8 Master Planning Lifecycle Phases, Decisions and Milestones

Each change to a Stakeholder system or an ATM service goes through a number of lifecycle phases, starting with R&D (comprises identification of needs, concept definition, feasibility studies and pre-industrial development and integration), implementation (comprises industrialisation and deployment), culminating with operational use, and ultimately ending with decommissioning. The execution of each phase corresponds to an activity and that activity comprises the production of business case, safety case and validation. For a correct interpretation of the meaning of each phase, please look at the expected milestone outcome (depicted in D6).

Not all phases are addressed in detail in the Master Plan. The roadmaps shown in Chapter 3 of the plan show only the "simplified lifecycle" as depicted on the left side of Figure 8.

8 Phases 0 to 5 are based on the E-OVCM lifecycle phases.

An important milestone for Master Planning is the Initial Operational Capability (IOC) date. This corresponds to the first time an operational improvement is needed to start delivering benefits. For enablers the IOC date implies that a change has been deployed and is ready for operations. The enabler IOC dates are driven by the timing of the operational improvements they support. IOC dates are therefore central in the Master Planning process. All earlier lifecycle phase dates have been planned according to the target IOC dates. The point in time where full stakeholder deployment is made is called the Full Operational Capability (FOC) date.

At the level of Master Planning, the major decisions are about:

- whether or not (and when) to start each lifecycle phase;
- what to do during each lifecycle phase (depends on synchronisation needs with other activities);
- reaching agreement on the completion of each lifecycle phase, i.e. the achievement of milestones.

The decision to start a lifecycle phase implies a commitment from all involved stakeholders in terms of schedule, financing and contributed resources.

In the context of SESAR, the use of standard lifecycle phases for planning R&D and Implementation activities has the following advantages:

- Lifecycle phases provide a framework which clearly scopes the type of work that has to be performed in the Work Programme [Ref 18];
- Lifecycle phases are designed to support a progressive refinement, development and validation from the high level concept (as specified in D3) to real, wide-spread operational use of a change;
- Lifecycle phases are designed to manage the development risks (feasibility, time and expenditure): the Feasibility phase is relatively short and relatively low budget. It serves to ensure early reduction of uncertainty and allow timely re-orientation of the Master Plan (if necessary), prior to the more expensive and time-consuming pre-industrial development and integration. This in turn is used to mitigate Industrialisation risks, and so on. Re-orientation of the Master Plan implies adjustments, prioritisation or even cancellation of developments, possibly in other parts of the Master Plan. This re-orientation cross-check must ensure the consistency and synchronisation of the various parts of the plan;
- The above underlines the importance of lifecycle related decision-making: each boundary between two phases is a checkpoint and decision point in the development and deployment of an operational or technical change. After each completion of a lifecycle phase, its results must be checked and used to update and maintain the Master Plan information. Go/no-go decisions for follow-on activities should be based on the basis of the most up-to-date Master Plan information.

2.3.3. <u>Pro-active Management of the Decision Calendar</u>

At the highest level, the objective of Master Plan execution is to realise ATM performance improvements not just of the required *magnitude*, but also in a *timely* fashion, so as to meet the performance targets required/expected for a certain date.

Even if the target concept is capable of delivering improvements of the required *magnitude*, and that progress in delivering these improvements is indeed made, there is still a risk that the improvements are not delivered in a *timely* fashion, due to slow progress in Master Plan execution.

Slow progress can have several causes:

- Lifecycle phases taking longer than originally planned;
- Lifecycle phases starting later than planned, with delays due to:
  - Lack of timely decision making;
  - Lack of synchronisation between prerequisite activities.

The European and global institutional decision-making timescales, in the context of SESAR's implementation, introduce the potential for significant risk to the desired timescale, unless the sequence and timing of decision-making is carefully managed.

To mitigate the risk of delayed lifecycle phase start, SESAR [Ref 16] has identified the need for proper planning and management of decision-making. This is seen at two levels:

- At overall system level, via the approval and buy-in to periodic Master Plan updates. The associated decision making is part of the Master Plan Maintenance process;
- At the level of Decision Plans for the key elements within the Master Plan (i.e. the road maps depicted in Chapter 3).

As already mentioned in section, IOC dates are central in the overall planning process. The declaration of IOC for an operational improvement or an enabler is a *major decision*. The date at which this decision is planned must be *realistic* (achievable), *coordinated* (to respect the logic of the deployment sequence and all dependencies) and also be *suitable* within the larger context of performance planning (i.e. to enable timely delivery of performance).

The total collection of IOC dates for operational improvements and enablers can be considered the *IOC Plan*. As part of the Master Plan Maintenance process, the realism, coordination and suitability of these dates will have to be periodically revisited. IOC dates will need to be advanced or delayed when changing circumstances dictate so.

Surrounding the IOC Plan (and governed by it) are two decision plans which are different in nature but closely connected and jointly developed, covering the key elements within the Master Plan:

- *Pre-IOC Decision Plan*: this covers all decisions which have to be taken within the context of R&D, Industrialisation, standardisation, regulation/legislation, investment, establishment of incentives etc.;

- *Post-IOC Decision Plan*: this is part of the detailed Deployment Plan (planned and monitored through the renewed ECIP/LCIP mechanism) that describes who will deploy what, when and where. It covers all decisions which have to be taken by the Stakeholders to achieve synchronised (air/ground) deployment between IOC and FOC, in line with network-wide and local performance/business needs, incentives and all regulatory and legislative obligations. This includes the financing and funding decisions and also any decommissioning decisions. The aim is to obtain commitment and achieve clear alignment of stakeholder plans with the Master Plan.

SESAR [Ref 16] has identified a number of reasons why decisions need to be planned ahead. The most significant ones are:

- Need for synchronisation of R&D activities: IOC dates of enablers are driven by the planned IOC dates of related operational improvements. This drives the calendar of events in the Pre-IOC Decision Plan;

- A lot of these events are decisions to be taken by external (institutional) decision-making bodies. The key decision points must be carefully planned and co-ordinated for specific meeting agendas between the different institutions as appropriate to ensure that they can be taken by the relevant deadline. In some cases this may require a Decision Plan extending up to 5 years ahead to ensure that the critical decision path is met on time;

- Often there is no time for activities to go round the institutional decision-making loop twice. Everything being presented for a formal decision must be accompanied by ALL the necessary justifications and supporting material.

The timing requirements, which follow from the above reasons, are illustrated in

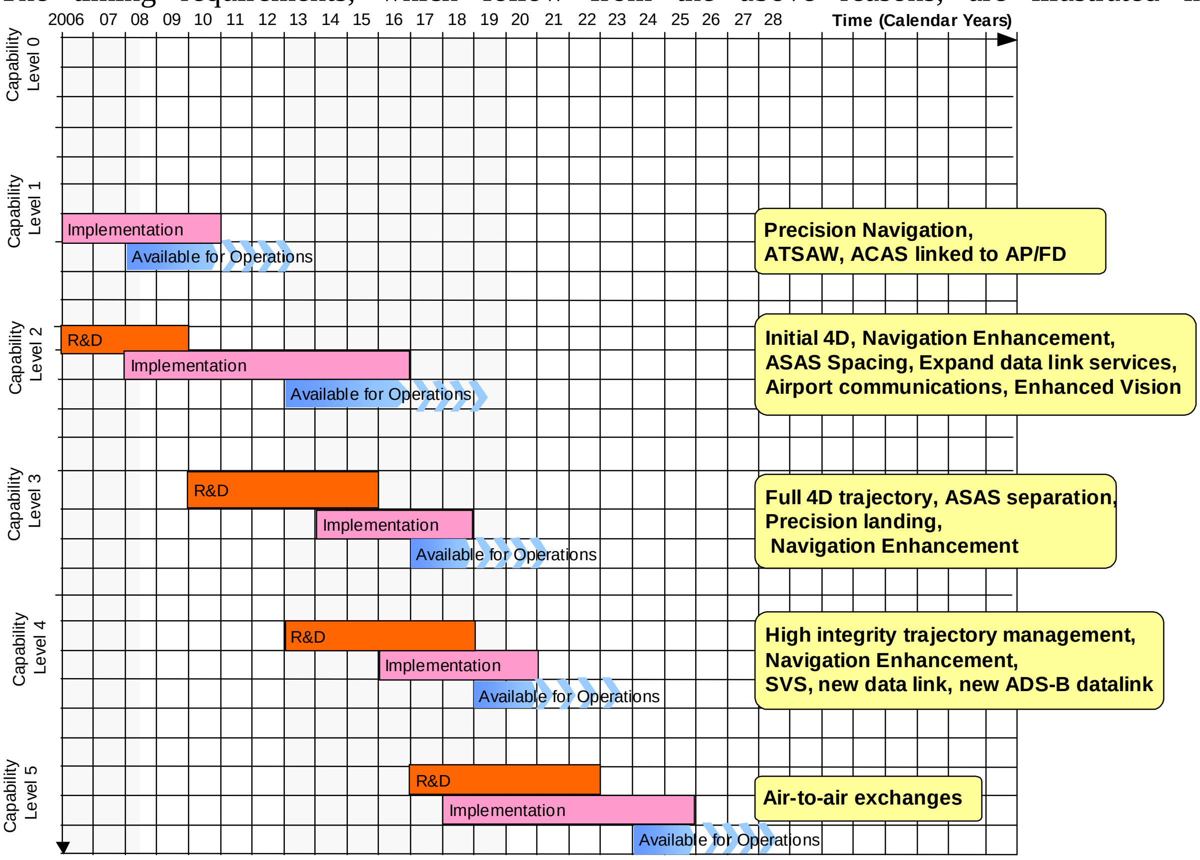


Figure **9**. The figure illustrates the dependency of a target start date on a single decision, but in reality there will often be many prerequisite decisions, which must be coordinated to prevent undue delay of the target start date. This again underlines the need for careful decision planning, followed by active management of the decision calendar. It should also be noted that the required time horizon of the Decision Plan varies: for certain international decision meetings like the World Radio Conference the planning horizon needs to be several years; for other decision bodies which are meeting frequently a look ahead of one year will be more than sufficient. It is clear that there is no need to define all decisions right from the start.

The current version of the Master Plan (with its breakdown of activities into lifecycle phases and associated milestones and decision points) can be considered as an initial version of the Decision Plan. The current D5 information is not specific and detailed enough to make a meaningful assessment of what has to be decided by whom, using which consultation and decision making process. During the SESAR Development Phase, it will be the responsibility of the SESAR JU to progressively refine the Decision Plan on R&D matters based on more detailed analysis of the Master Plan with supplemental input from R&D results.

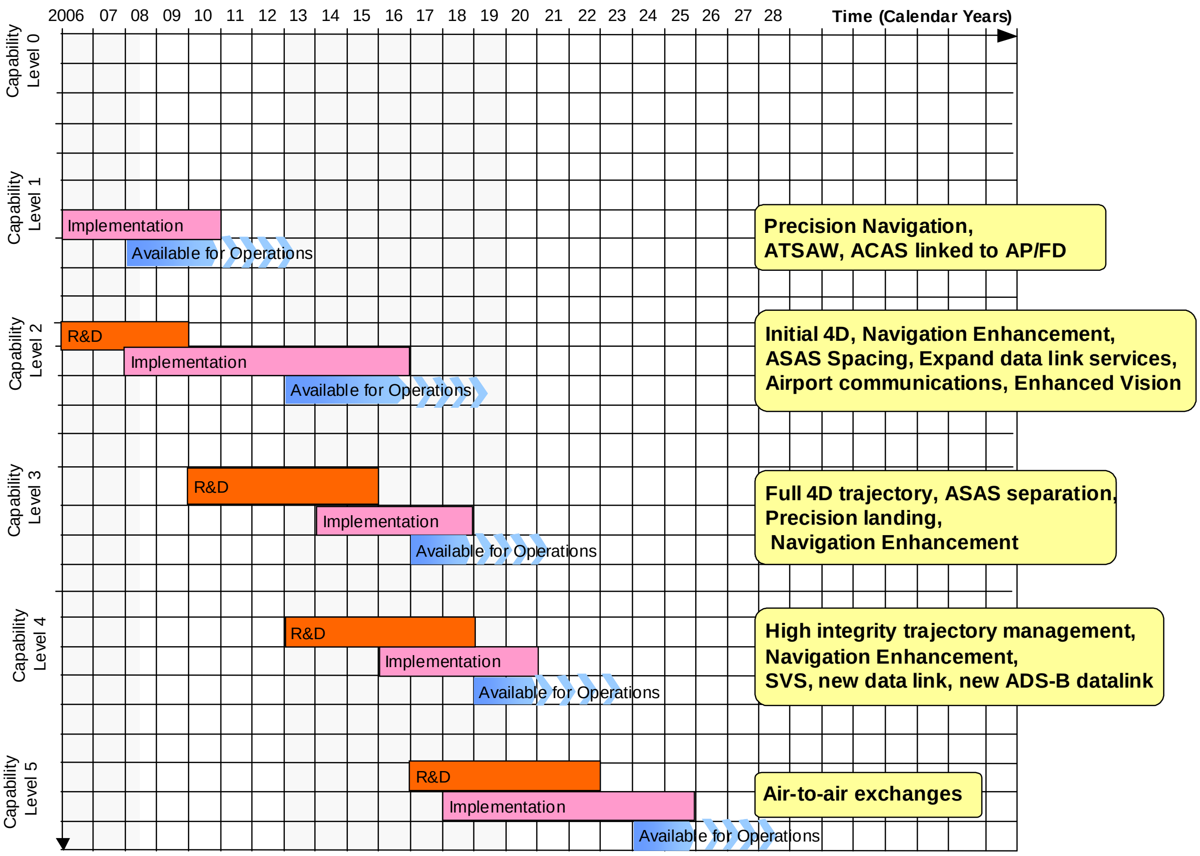


Figure 9 Timing Requirements in Decision Planning

Risk management (Master Plan high priority risks are addressed in Chapter **Error! Reference source not found.** of this document) has different decision-making needs. Risk mitigation actions are pre-planned responses to the potential occurrence of certain events. When a risk event occurs (or is about to occur), it is essential that the associated mitigation action can be launched without delay. Those responsible for the execution of the action must ensure rapid response decision-making.

2.3.4. Master Plan Maintenance

The Master Plan will guide the future of ATM in Europe over the next decades and forms the basis for the programme of work for the first part of the SESAR implementation phase. It will become a “rolling” plan that will be regularly updated in accordance with the results from the R&D activities starting under the responsibility of the SESAR JU. Continuous performance monitoring will need to be undertaken to ensure that the future ATM activities will deliver the agreed benefits defined within an agreed performance framework.

This Master Plan will be handed over to the SESAR JU that is responsible for its execution and updates for the coming years.

3. Plan for Implementing the ATM Target Concept

This chapter presents:

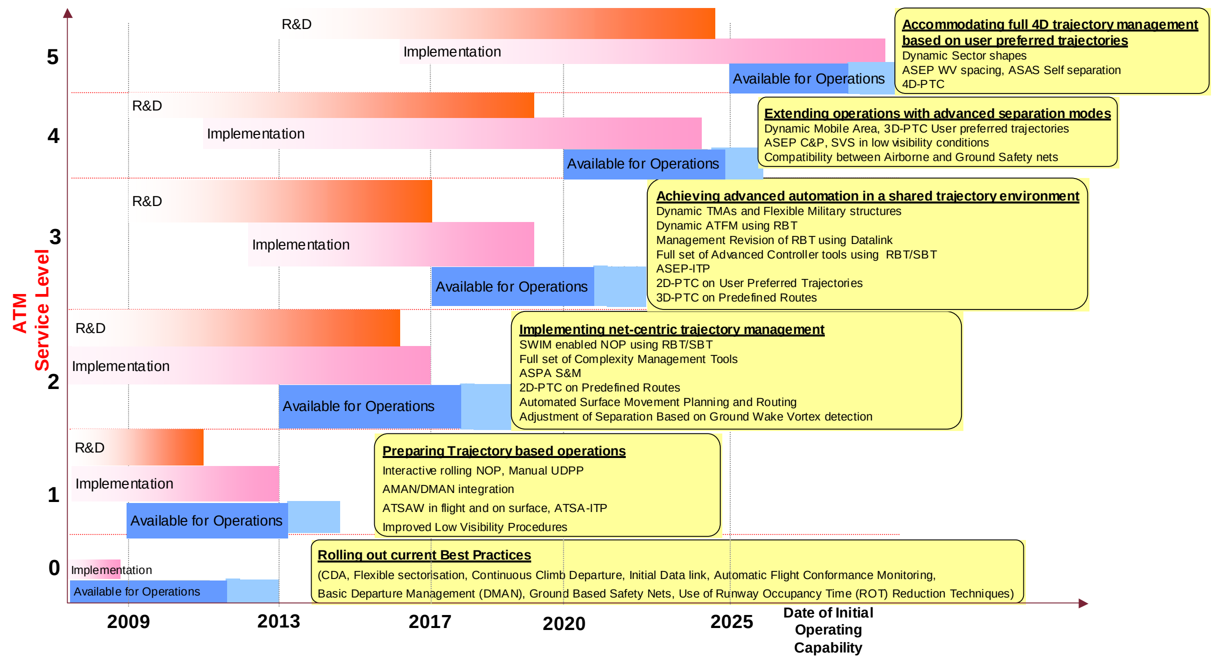
- How and by when the ATM Service Level of the European ATM system needs to be enhanced to respond to evolving performance needs in the scope of the ATM Target Concept. This is presented in the Operational Evolution Roadmaps showing per ATM Service Level the changes for each Line of Change (LoC)[9] of the ATM Target Concept;

- The deployment plan for the evolution towards System Wide Information Management (SWIM);

- The other enabling changes (standardisation, legislation, regulation and integrated management of environment, safety and security) to be implemented to support the European ATM system evolution;

- What and when should Stakeholders deploy processes and enablers to realise ATM Capability Level enabling expected ATM Service Level. This is presented in the Stakeholder Deployment Plans, which also include the lifecycle for R&D and Implementation.

9 Lines of Change (LoC) represent the main operational areas that describe the evolution of the ATM environment.



Note: Long R&D and implementation durations are the result of combining many data but do not reflect the time needed to introduce a specific improvement at a specific location.

Figure 10 Master Plan Overview

Since **Safety** is a design driver, any Quality of Service increase shall not deteriorate the Safety level and any Capacity increase shall imply a proportionate increase in Safety. However, the Safety target would be met if in addition to the previous measures:

- At Airports (see LoC#10) specific initiatives like runway incursion are early deployed;
- New communication, navigation and surveillance technologies are being introduced providing better access to information and enabling the position of every aircraft (including GA) and vehicle to be electronically visible to other users of the system;
- Continuous improvement of Safety Net (see LoC#9) is implemented;
- Any Safety improvements are supported by an appropriate Safety Management Framework.

The performance based approach developed within SESAR Definition Phase came to the following conclusions: since any optimisation of the flight profile translates directly to an overall reduction of gaseous emissions, **any** Flight Efficiency improvement will have a positive impact on **Environment**. However, the Environment target would be met if in addition to the Flight Efficiency measures (see Flight Efficiency paragraph):

- At Airports (see LoC#10) specific initiatives such as expansion of best “practices” (e.g. reduction of taxi time) are being deployed;
- An Environmental Sustainability culture within ATM Governance is being developed.

The achievement of the **Capacity targets** will be supported by:

- In the short-term, the best use of existing capacity through a better planning process (see LoC#3 & LoC#4);

- In the mid-term, an increase of the ATCO Productivity through the use of New Separation Modes (see LoC#8), new controller support tools (see LoC#6, LoC#7) and a reduction of trajectory uncertainty (see LoC#5, LoC#1);

- At Airports (see LoC#10 “”), the rolling-out to best in class any runway utilisation improvements, taking into account the needed infrastructure enhancement.

The achievement of the **Efficiency targets** will be supported by:

- An increase of the Capacity level in order to reduce departure delay;

- The move from Airspace to Trajectory Based Operations (see Loc#2);

- In the longer run an increase of the benefit from the Trajectory Based Operations through the use of New Separation Modes (see LoC#8).

The achievement of the **Predictability targets** will be supported by:

- Any improvement in the planning process (see LoC#3) and queuing process (see LoC#7);

- Any improvement of operations under adverse conditions (see Loc#10).

The achievement of the **Flexibility targets** will be supported by:

- Any improvement in the planning process towards a more collaborative approach (see LoC#3).

Finally, the achievement of the **Cost Effectiveness target** will be supported by:

- An increase of the ATCO Productivity (see Airspace Capacity : LoC#5, 6 , 7 & 8);

- A cost effective approach when implementing any enablers related to an operational improvement.

The performance Objectives and Targets have been developed during SESAR Definition phase and captured in D2 [Ref 3]. This analysis has been used as the basis of the ATM Target Concept; it is of primary importance to consolidate the SESAR Performance Framework by developing targets for all 11 KPAs, assessing their trade-offs.

This chapter provides an overview of the Master Plan information implying that not all dependencies between Operational Improvement (OI) Steps and enablers can be shown. It shows graphical roadmap information at an aggregated level, i.e. per ATM Service Level (operational evolution, see section 3.1) or ATM Capability Level (stakeholder deployment plan, see section 3.3). In other words, each ATM Service Level groups a number of OI Steps and each ATM Capability Level a number of enablers. As a consequence, the steps of the lifecycle shown in each roadmap are overlapping.

Detailed Master Planning information is available at the level of individual OI steps in the DLTs [Ref. 6, 7 and 11] and in the electronic Master Plan (www.atmmasterplan.eu). This includes planned start and end dates of individual lifecycle phases. At this detailed level the lifecycle phases are sequential and non-overlapping.

As shown in Figure 11, links between the Stakeholder Deployment Plans and the Operational Evolutions roadmaps exist, and are inherited from the detailed traceability between enablers and OI steps included in the e-Master Plan. These links are outlined in the Stakeholder deployment plans that include, for each ATM Capability Level, a reference to the supported operational Line of Change (LoC).

Note: LoC#1 (Information Management) is not illustrated in the Operational Evolution roadmaps, as a specific section is totally dedicated to the description of the evolution towards SWIM, which is recognize as the common underlying principles of European ATM evolution.

The Integrated Management System roadmaps included in the Master Plan cover Safety, Security, Human Performance and Environment. These areas capture improvements (not directly of an operational nature) that contribute to the performance in one ore more KPAs. Other supporting subjects, not less important but with a supporting role to meet the R&D requirements/needs, are Validation Platforms R&D needed to make possible the validation activities required in the plan. The mentioned Validation Infrastructure needs are taken on board in the Work Plan (D6).

EAEA/SOA as a pre-requisite will, through the identification of each stakeholder strategic business objectives, lead to an efficient allocation of the business objective to each stakeholder systems. This will dictate how business services in support of the operational concept are realised both from a procedure and system point of view. Every system enabler roadmap is therefore impacted by this new framework.

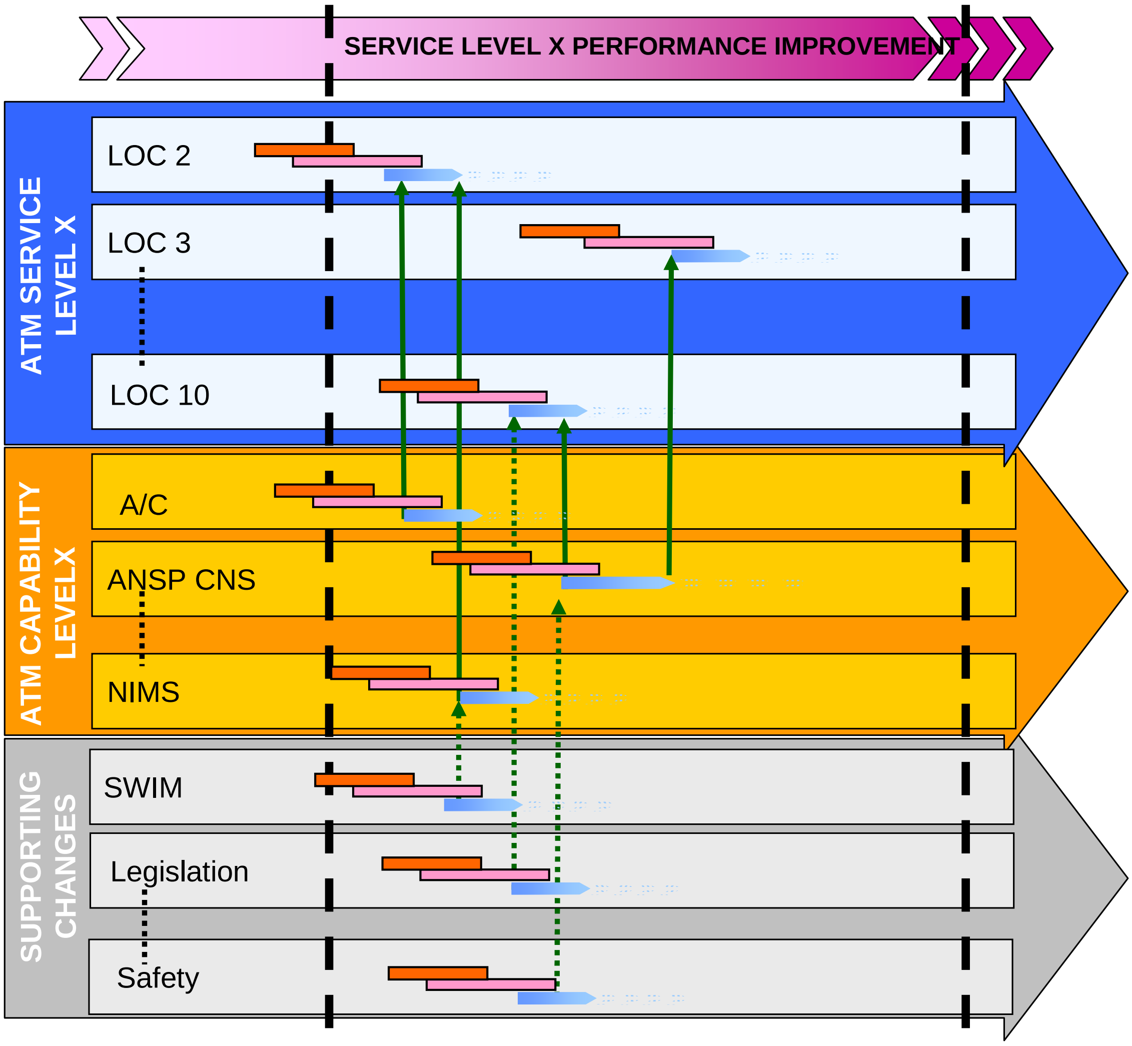


Figure 11 Links between the different types of roadmaps

The dates of the lifecycle phases have been determined on the basis of the planned IOC date (i.e. start of operation) and the estimated time required to complete the necessary preceding lifecycle phase activities.

Figure 12 presents the legend applicable to all the roadmaps in the present chapter. It illustrates the use of the simplified lifecycle as presented in section 3.1. The IOC date for the respective activity (Service Level / Capability Level) has been used as the basis to determine the timeline for the implementation and R&D activities [Ref 8].

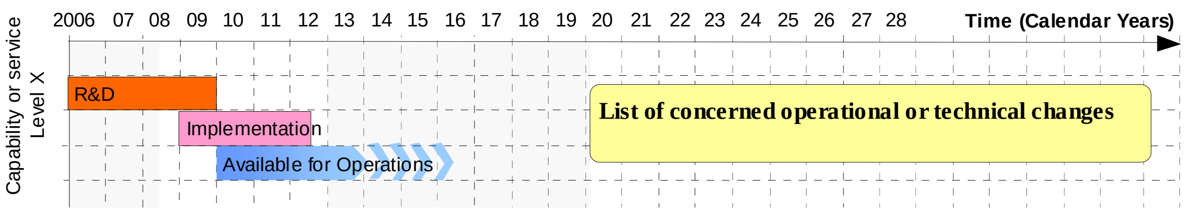


Figure 12 Roadmap legend

3.1. Operational Evolutions Roadmaps

Operational Evolutions are described for each of the ATM Service Level 0 to 5, covering the entire period from now till the full implementation of the ATM Target Concept [Ref 4].

Note: Following recent adoption, in February 2008, of the European Airspace Strategy [Ref 19], updates have been incorporated in the presentation of Line of Change 2 for the different ATM Service Level.

3.1.1. ATM Service Level 0

Service level 0 consists of rolling out current best practices and deploying available technologies, aiming at providing the processes and system support for efficient collaborative planning and timely decision making across the network. The on-going initiatives support the delivery of service level 0, ensuring that the improvements can be implemented in a short timeframe provided that the required level of stakeholder involvement is secured. These initiatives (e.g. DMEAN, LINK 2000+, etc) have been already highlighted in the previous deliverables.

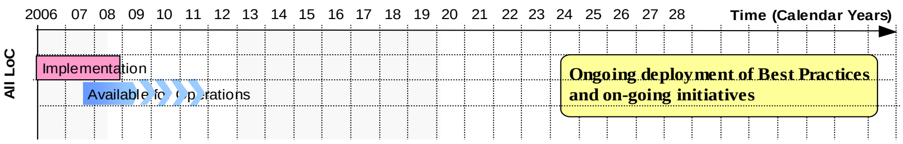


Figure 13 ATM Service Level 0

LoC#2–Moving from airspace to trajectory based operations
Ongoing deployment of Best Practices: Multiple Route Options & Airspace Organisation Scenarios; Cross-Border Operations Facilitated through Collaborative Airspace Planning with Neighbours; Continuous Descent Approach (CDA); Flexible Sectorisation Management; Modular Sectorisation Adapted to Variations in Traffic Flows; Continuous Climb Departure; Terminal Airspace Organisation Adapted through Use of Best Practice, PRNAV and FUA Where Suitable; Moving Airspace Management Into Day of Operation; Harmonised EUROCONTROL ECAC Area Rules for OAT-IFR and GAT Interface; Modular Temporary Airspace Structures and Reserved Areas.
LoC#3 - Collaborative Planning using the Network Operations Planner
Ongoing deployment of Best Practices: Enhanced Seasonal NOP Elaboration; ATFM Slot Swapping; Interactive Network Capacity Planning; Enhanced Flight Plan Filing Facilitation.
LoC#4 - Managing the ATM Network
Ongoing deployment of Best Practices: Network Performance Assessment; ATFCM Scenarios; Management of Critical Events; Coordinated Network Management Operations Extended Within Day of Operation; Improved Operations at Airport in Adverse Conditions Using ATFCM Techniques.
LoC#5 - Managing Business Trajectory[10] in real time

[10] For military operations the term “Business Trajectory” shall also be understood as “Mission Trajectory”

Ongoing deployment of Best Practices: Automated Support for Traffic Load (Density) Management; Voice Controller-Pilot Communications (En-Route) Complemented by Datalink; Automated Assistance to Controller for Seamless Coordination, Transfer and Dialogue; Sector Team Operations Adapted to New Roles for Tactical and Planning Controllers.
LoC#6 - Collaborative ground and airborne decision tools
Ongoing deployment of Best Practices: Automated Assistance to ATC Planning for Preventing Conflicts in En-Route Airspace; Automated Flight Conformance Monitoring.
LoC#7 - Queue Management Tools
Ongoing deployment of Best Practices: Basic Departure Management (DMAN); Arrival Management Supporting TMA Improvements (incl. CDA, P-RNAV).
LoC#9 – Independent Cooperative ground and airborne safety nets
Ongoing deployment of Best Practices: Ground Based Safety Nets (TMA, En-Route).
LoC#10 - Airport Throughput, Safety and Environment
Ongoing deployment of Best Practices: Additional Rapid Exit Taxiways (RET) and Entries; Reduced Risk of Runway Incursions through Improved Procedures and Best Practices on the Ground; Improved Operations in Adverse Conditions through Airport Collaborative Decision Making; Improved Turn Around Process through Collaborative Decision Making; Collaborative Pre-departure Sequencing; Improved De-icing Operation through Collaborative Decision Making; Use of Runway Occupancy Time (ROT) Reduction Techniques; Interlaced Take-Off and Landing; Reduced Water Pollution; (Local) Monitoring of Environmental Performance; Enhanced Ground Controller Situational Awareness in all Weather Conditions; Guidance Assistance to Aircraft on the Airport Surface; Airport CDM extended to Regional Airports; Automated Alerting of Controller in Case of Runway Incursion or Intrusion into Restricted Areas; Reduced ILS Sensitive and Critical Areas; Brake to Vacate (BTV) Procedure; Aircraft noise mitigation at and around airports; Aircraft fuel use and emissions management at and around airports; Aircraft fuel use and emissions management in the en-route phase.

3.1.2. <u>ATM Service Level 1</u>

Service Level 1 aims to achieve the required interoperability between ATM partners to enable smooth migration to trajectory-based operations, taking initial benefit of "manual" User Driven Prioritisation Process (UDPP). The route network will be increasingly flexible to offer more options to airspace users. More advanced procedures and systems will be introduced to raise the safety and throughput of airports/sectors to the performance targets for the period. This will built upon conventional modes of separation while paving the way for new methods of control. Service Level 1 improvements will be carried out in compliance with the societal need for further environmental protection.

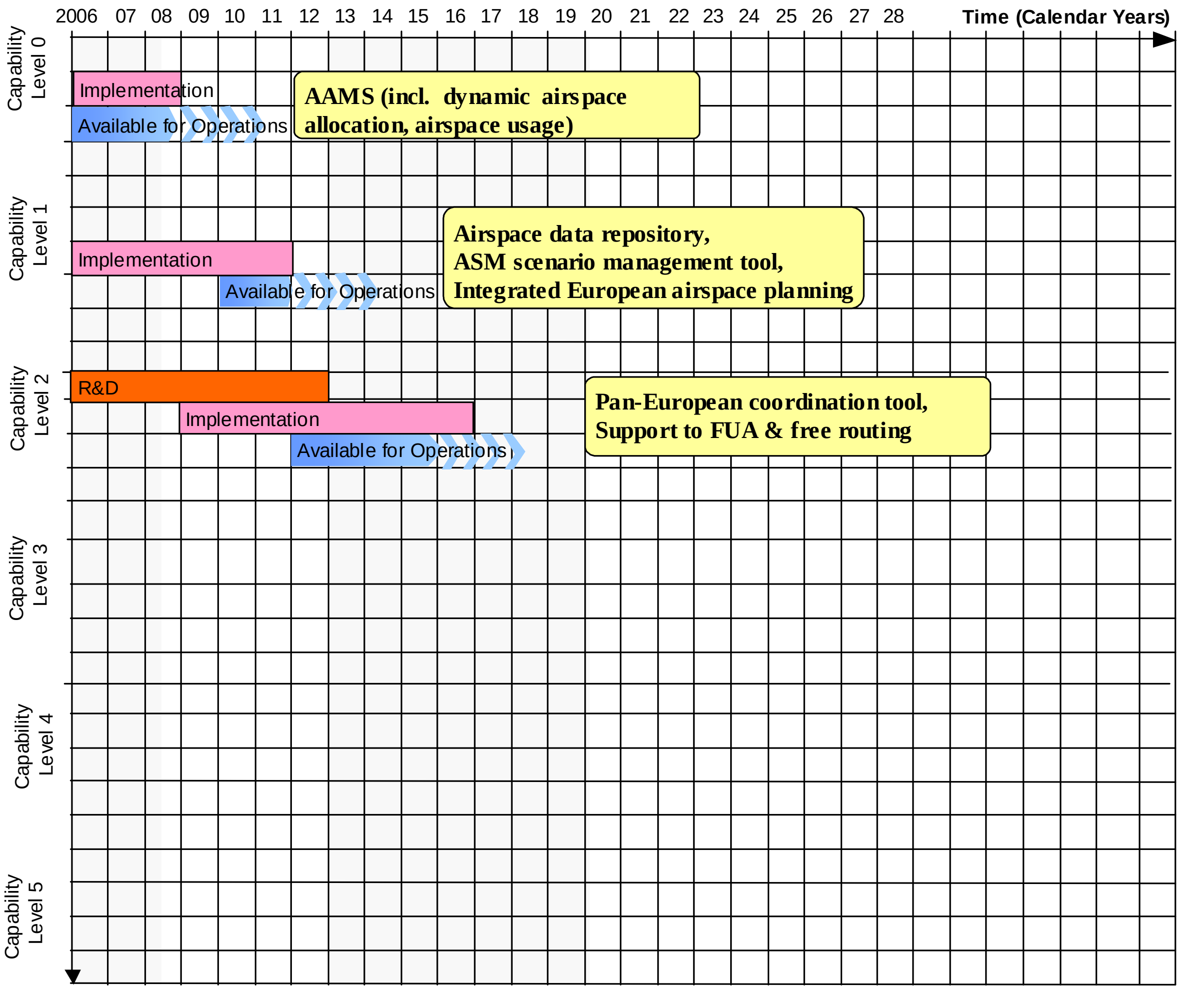


Figure 14 ATM Service Level 1

LoC#2–Moving from airspace to trajectory based operations
Uniformed application of 7 airspace classes <= FL 195: Uniformed application of the rules associated with the 7 ICAO airspace classification at or below FL 195.
Optimum trajectories: Implement optimum trajectories in defined airspace at particular times.
Further Improvements to Route Network and airspace: Implement airspace structure (Route/sector) across airspace boundary to better align route and sectors with traffic flow and to accommodate more efficiently the various type of airspace users.
Enhanced ASM-ATFCM coordination: Deploy collaborative activities to optimise the utilisation of the available capacity based on the continuous assessment of network impact of the expected airspace allocations. Deploy systems and procedures allowing AMC and other parties to design, allocate, open and close military airspace structures on the day of operations.
Automatic Support for dynamic sectorisation: Deploy dynamic management of airspace/route structures based on pre-defined sector sizing and constraint management in

order to pre-deconflict traffic and optimise use of controller work force.
MIL flight planning and transit system (aeronautical data): Deploy filing of flight plans in a common format (=ICAO FPL format) for military flights i.e. GAT, mixed OAT/GAT and all Operational Air Traffic flights for which a filed flight plan is required and the provision of all OAT-IFR flight data and aeronautical information required for the ATM systems support of military aerial operations. Deploy a pan-European OAT-IFR Transit Service (OATTS), which connects national structures and arrangements to form a flexible system facilitating OAT-IFR flights across Europe.
Enhanced Terminal design using P-RNAV: Deploy RNAV routes to facilitate improvements in the efficiency and capacity of Terminal Airspace through the provision of increased flexibility and reduced route separation. Includes also the deployment of environmental-friendly procedures like steep and curved approaches. Steep final approaches can be supported by Approach Procedures with Vertical Guidance (APV) with different Minima decision (from LNAV/VNAV to LPV or RNPx).
R&D
Develop and validate the Airspace Allocation and Usage concepts by formalisation and modelling of Traffic Demand and Capacity Balancing (DCB) and Airspace Management (ASM) scenarios. Develop and validate the interaction of different actors for different time horizon and scenarios. Assess system support needed for optimising the interactions between actors and processes. Develop airspace design guidance material for TMA merging techniques based on P-RNAV. Identify divergences of flight planning provisions & procedures for military flights. Elaborate requirements on civil-military flight plan interoperability related to the SESAR concept of Military Mission Trajectory and its impact on military flight planning needs. Analyse convergence of the military flight planning with the ICAO Future Flight Plan. Determine Flight plan security requirements for State aircraft flights in the SESAR environment, in relation to those for scheduled, non-scheduled and private flights. Identify Military needs in terms of validated aeronautical data not covered in ICAO AIP. Assess applicability of civil standards (e.g. AIXM) for military aeronautical data. Consolidate rules (EUROAT) and identify mechanisms criteria and structures to enable the accommodation within EATMN of military aerial operations conducted as OAT-IFR in a way that improves ATM efficiency and cost effectiveness, reducing fragmentation and duplication of ATM infrastructure. This includes: development of new simulation systems that reflect characteristic military en-route and airspace requirements, harmonisation of military OAT flight plan and the development and validation of solutions to promote the compatibility of military aeronautical data with civil standards (including security aspects). A Pan-European OATTS also entails the need to identify standardised and performance-based CNS requirements interoperable with civil requirements. Develop and validate simulation tools to support Airspace Reservation dimensions and

locations.
LoC#3 and LoC#4 - Collaborative Planning using the NOP / Managing the network
Interactive Rolling NOP[11]: Implement interactive Network Operation Plan providing an overview of the ATFCM situation from strategic planning to real-time operations readily available online to stakeholders for consultation and update as and when needed subject to access and security controls.
Short Term ATFCM measures: In order to close the gap between ATC and ATFCM, operational procedures to enhance scenario sharing are deployed which involve coordination between more than one ACC, the Airport Operations and the CFMU. The aim is to maximise the efficiency of the system using flow management techniques close to the real time operations.
Manual User Driven Prioritization Process (UDPP): Implement and expand use of manual UDPP to enhance capacity and efficiency.
Civil-military cooperation assessment: Implement and monitor Military KPIs on Airspace Efficiency, Mission Effectiveness and Flexibility and agree civil-military KPIs.
Sustainability performance assessment: ATM Performance Monitoring is implemented through network efficiency indicators (in particular for Environment and Military aspects) to monitor the performance of the ATM network. Deploy and monitor efficiency indicators to describe the environmental performance of the ATM network.
R&D
Develop dynamic coordination process involving more than one ACC, the Airport Operations and the Network managers. Validate its feasibility and expected optimisation in capacity allocation against network throughput and achieved/expected balance in providing capacity. Elaborate and validate the process to handle pro-active scenarios (known events) as well as re-active scenarios (unplanned, but prepared) for mitigating the consequence of critical events. Define and validate, the ATM network environmental performance indicators, as well as civil-military coordination monitoring processes and related measurable KPIs. Define models to quantify noise and other environmental loads in airport environment, leaving quantitative assessment of local pollution levels to local policy decision making.
LoC#5–Managing business trajectory in real time
Cruise-Climb Techniques: Deploy coordination of optimised En-Route Cruise-Climb setting between pilot and controllers so as to allow aircraft to climb as weight is decreased though fuel burn. This results in more optimised trajectories.
R&D

[11] Moved from Service Level 0 in D4 to Service Level 1 in D5 due to recent developments

Determine the modifications necessary to ground systems (and potentially airborne systems) to enable the use of cruise-climb techniques.
LoC#7-Queue management tools
DMAN and pre-departure: Introduce Departure Management synchronised with pre-departure sequencing.
AMAN extended in En-Route: Introduce Arrival Management Extended to En-Route Airspace.
AMAN/DMAN Integration: Introduce integrated Arrival Departure Management for full traffic optimisation, including provision of assistance to the controller within the TMA to manage mixed mode runway operations, and identify and resolve complex interacting traffic flows.
R&D
Define and validate the appropriate scope of AMAN operations within the scope of temporal horizon and geographical areas Define and validate principles on how to best integrate arrival and departure management constraints.
LoC#8-New separation modes
ATSAW in flight and on surface: Deploy Airborne Traffic Situation Awareness (ATSAW) in the cockpit by displaying surrounding traffic while airborne and on the airport surface.
ATSA-ITP: Deploy Airborne Traffic Situation Awareness In Trail Procedure (ATSA-ITP) in Oceanic Airspace.
Manual ASAS S&M: Deploy ASAS Manually Controlled Sequencing & Merging operations in applicable TMAs, requiring the pilot to follow the speed commands manually.
R&D
Asses benefits of Manual S&M for different category of TMAs in the ECAC Area. Analyse its impact on runway throughput of relative Time Based Separation (ASAS) vs. Absolute Time Based Separation (RTA) Vs Absolute Time based separation (RTA) followed by relative time-based separation (ASPA S&M). Analyse and compare the use of single or multiple merging points for sequencing arrivals to the airport. Assess benefits of ASEP ITP over ASPA-ITP. Study how UAS Operations may be integrated with other managed air traffic in an ASAS Separation environment.
LoC#9 – Independent Cooperative ground and airborne safety nets
ACAS linked to Auto-pilot/FD display: Enhanced ACAS through use of Autopilot or Flight Director.
LoC#10- Airport Throughput, Safety and Environment

Improved Low Visibility Procedure: Introduce improved operations in low visibility conditions through enhanced ATC Procedures collaboratively developed at applicable airports involving in particular an harmonised application across airports and the use of optimised separation criteria. Deploy final approaches with vertical guidance procedures to enable Cat I like operations.
ATSA-VSA: Introduce enhanced Visual Separation on Approach (ATSA-VSA), to assist crews to achieve the visual acquisition of the preceding aircraft and then to maintain visual separation from this aircraft.
Reduced aircraft separations: Introduce new procedures whereby under certain crosswind conditions it may not be necessary to apply wake vortex minima. Introduce fixed reduced separations based on wake vortex prediction.. Introduce Constant time separations independent of crosswind conditions and wake vortex existence are introduced.
Parallel runway operations: Reduce dependencies between runways by implementing more accurate surveillance techniques and controller tools as well as advanced procedures.
Foreign Object Detection: Implement system providing the controller with information on Foreign Object Debris detected on the movement area.
Dynamic surface navigation for aircraft: Introduce guidance assistance to airport vehicle drivers through the provision of an airport moving map showing taxiways, runways, fixed obstacles, and their own mobile position.; also introduce tools that increase the airport vehicle drivers Traffic Situational Awareness (TSA) through the provision of information regarding the surrounding traffic (incl. Both aircraft and airport vehicles) during taxi and runway operations displaying it in the vehicle driver's cockpit. Introduce Guidance Assistance to Aircraft on the Airport Surface using CDTI moving map display including dynamic traffic context information and status of runways and taxiways, obstacles, route to runway or stand with ground signs (stop bars, centreline lights, etc.) are triggered automatically according to the route issued by ATC.
Improved surface markings:: Introduce improvements in lay-out of taxiway and signalling of location of runways with respect to the terminal/apron, including better placed runway crossings, use of additional perimeter taxiways, avoiding alignment of the main taxiways with entries or exits to prevent runway incursions.
Time Base separation for arrivals: Introduce time based separation procedures for arrivals.
Visual Contact Approaches: Introduce visual contact approaches.
R&D
Develop Guidance Material for best practices on flight deck procedures for runway crossing, while taxiing and the communication with the air traffic controller regarding aerodrome signage, markings and lighting. Validate the use of weather information to improve predictability and reliability of managing the traffic on the airport surface (e.g. meteorological information in respect of aircraft de-icing and prediction of thunderstorm). Assess the feasibility of using meteorological information to predict braking performance on surface

airport.

Develop and validate requirements for improved information provision to aircraft and vehicles of their position, routing and also information regarding taxiways, runways and fixed obstacles.

Develop and validate procedures to improve separation through exploitation of Wake Vortex prediction for arrivals and departures.

Consolidate approval of VFR procedures for IFR traffic operations.

3.1.3. ATM Service Level 2

Service Level 2 introduces the fundamental changes underpinning the SESAR Concept of Operations thanks to the progressive implementation of an information rich and information sharing environment with SWIM supporting the Shared Business Trajectory. More and more user-preferred trajectories will be accommodated along with Functional Airspace Block (FAB) implementation over Europe, enabling more direct routes in upper airspace. The User Driven Prioritisation Process (UDPP) will be applied defining prioritisation as the result of a collaborative process involving all partners. New modes of separation will be introduced (2D-PTC) and ASAS Spacing applications will be introduced in terminal areas. Advanced environmental friendly operations will be used in higher density terminal areas, with the introduction of 3D trajectory management and new controller tools. Surface movement operations will benefit from increased automation and improved surface navigation. Positional awareness will be improved through the application of visual enhancement technologies.

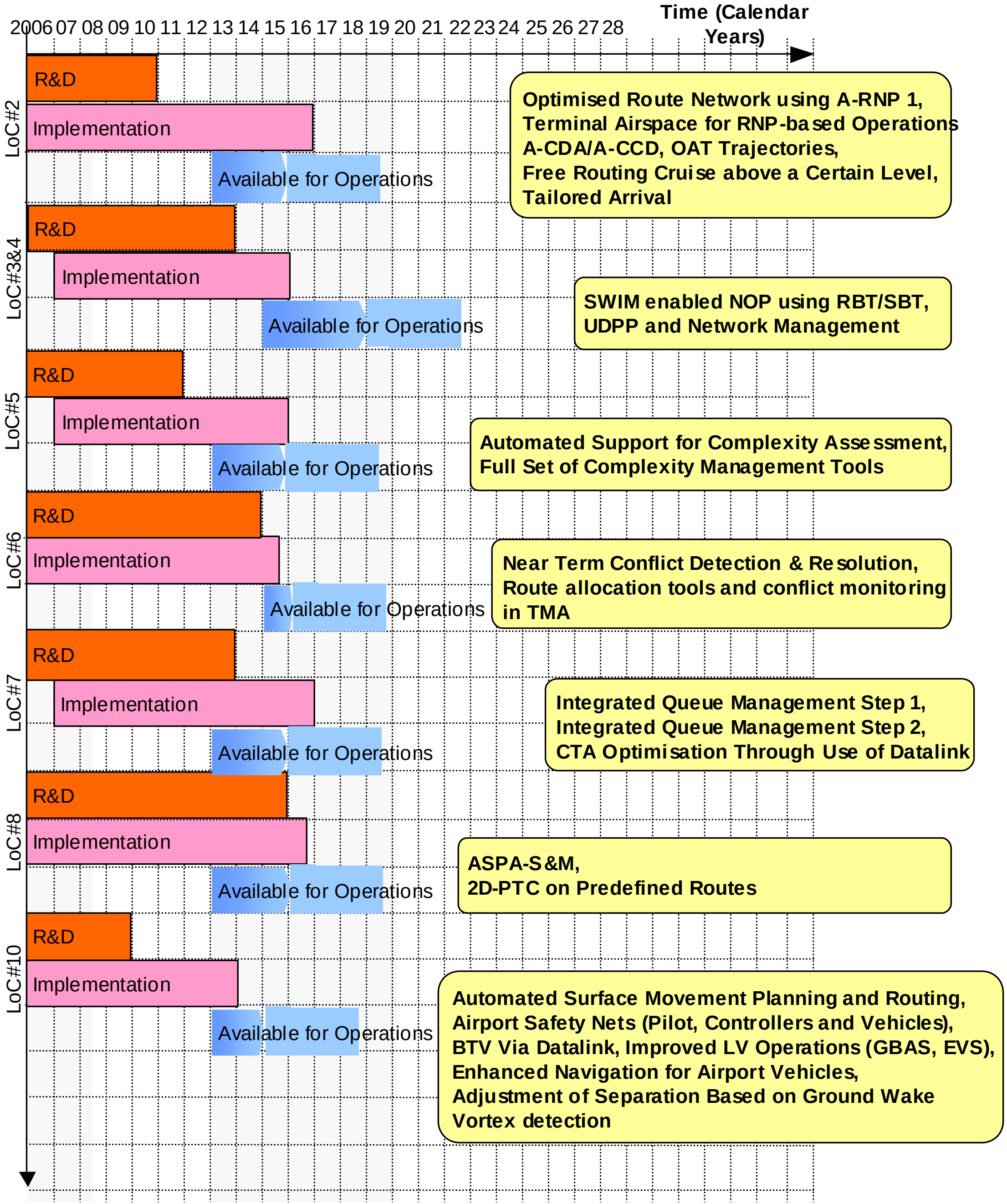


Figure 15 ATM Service Level 2

LoC#2–Moving from airspace to trajectory based operations
Optimised Route Network using Advanced RNP 1 (new RNP navigation specification for Terminal airspace routes): Spacing between routes is reduced where required, with commensurate requirements on airborne navigation capabilities; tactical parallel offset is increasingly used as alternative to vectoring.
Terminal Airspace for RNP-based Operations: Implement A-RNP1 SIDs and STARs; redefine holding areas in terms of size and location. Introduce RNP-based instrument procedures with vertical guidance through the provision of stabilised approaches, and therefore reduce the potential for CFIT (Controller Flight Into Terrain).

A-CDA: Deploy Advanced Continuous Descent Approach (ACDA) in higher traffic density, optimised for each airport arrival procedure, enabling aircraft to fly, as far as possible, their individual optimum descent profile; deploy Tailored Arrival routing from Top of Descent (TOD) to Initial Approach Fix (IAF) or to runway taking in account other traffic and constraints. **A-CCD**: Deploy Advanced Continuous Climb Departure (ACCD) in higher traffic density.
OAT Trajectories: Deploy interfacing of Military Mission Trajectories with Business Trajectories.
Free Routing Cruise above a Certain Level: Deploy free routing in Upper Airspace independent from route network in cruise.
Tailored Arrival: Deploy Tailored Arrival procedures in appropriate airport area.
R&D
Elaborate military area sharing concept in respect of flight planning process, classes of traffic, aircraft capabilities and phases of flight. Elaborate and then demonstrate the feasibility and benefits of the advanced flexible use of airspace (AFUA) (e.g. military variable profile area (MVPA), variable geometry area (VGA) and dynamic mobile area (DMA)). Elaborate A-CDA, A-CCD and tailored arrivals in respect of: evolution towards full 4D operation; use of Datalink to coordinate trajectories in advanced climb and descent operations. Assess the impact of advanced climb and approach/descent procedures on airport operations and runway capacity; feasibility of A-CDA and tailored arrivals procedures in a high traffic density/complexity environment. Validate where a fixed Route Network is still needed and the method of interfacing Free Route airspace with a fixed Route Network (including Rules and Procedures, impact on workload, economic justification, etc.). Assess the transition aspects related to accommodating OAT routes in a free route environment. Study military aircraft capabilities to support separation modes and possible needs in terms of ground-based 4D trajectory support.
LoC#3 and LoC#4 - Collaborative Planning using the NOP / Managing the network
SWIM enabled NOP using RBT/SBT: Implement processes enabling the publication of Shared Business/Mission Trajectories (SBT) by airspace users. The Shared Business / Mission Trajectory (SBT) is made widely available for ATM planning purposes to authorized users. Reference Business/Mission Trajectories (RBT) are agreed through Collaborative Flight Planning.
UDPP and Network Management: Deploy the User Driven Prioritisation Process (**UDPP**) and implement the network management function to assist airspace users in the UDPP process.
R&D
Analyse impact of climatic factors for optimisation of route and long-term planning. Develop new ways for the Collaborative flight planning process leading to the publication of

RBT (a complete Flight Planning concept should define all of the information that is needed by ATM from the Airspace User at all stages leading up to the flight). Study how to integrate airports in to SBT/RBT revisions process. Define and Validate the User Driven prioritisation process and procedures to optimize Demand and Capacity Balancing management. Develop and validate the visualisation tools covering all stakeholders' information access and performance needs to operate NOP. In particular, develop facilities that support Airspace Users in planning their 4D trajectories/missions (SBTs) through the NOP process while taking into account airspace availability, other traffic operations, airport's operational plans, Meteo and the Users' own exploitation plans. Define and validate all factors and triggering conditions, the roles & responsibility of the different actors impacting the UDPP process (e.g. temporal horizon,. major hub airports, Departure congestion, Arrival congestion, Airspace congestion, categories of airspace users). Assess the impact of the generalisation of UDPP process within ECAC on synchronisation and stability of NOP process. Elaborate the concept to establish a clear and beneficial frontier between dynamic ATFCM/DCB and complexity management. Define and validate operational process and procedures aiming at balanced and minimised constraint management mechanism including Airlines preferences. Develop and validate supporting tools for the elaboration, assessment, negotiation and implementation of DCB/ATFCM scenarios.
LoC#5 - Managing Business Trajectory in real time
Automated Support For Complexity Assessment: Deploy ground systems to continuously monitor and evaluate traffic complexity (in a certain airspace volumes), in order to predict upcoming congestions and support dynamic airspace management. Support ATCOs in identifying and resolving local complex situations: assessment of evolving traffic patterns and evaluation of opportunities to de-conflict or to synchronise trajectories.
Full Set of Complexity Management Tools: Deploy Automated Controller Support for Trajectory Management and Ground based Automated Support for Managing Traffic Complexity Across Several Sectors (e.g. MSP).
R&D
Identify and validate airspace volumes subject to complexity management and required level of accuracy. Analyse how the complexity assessment can be integrated in ATFCM processes. Specify and develop tools to predict complexity and provide the capability to trial complexity reduction measures. Define responsibilities between regional and sub-regional/local network management functions. Develop and validate operational procedures and analyse their implications (e.g. human machine

interaction on workload, safety) for trajectory revision. Assess cost and benefits of RBT process. Validate adapted sector team operations to new roles in real environment. Determine usability of complexity data for capacity calculations. Assess impact of different separation modes on determination of traffic complexity and controller task-load.
LoC#6 - Collaborative ground and airborne decision making tools
Near Term Conflict Detection & Resolution: Deploy automated Support for Near Term Conflict Detection & Resolution and Trajectory Conformance Monitoring. **Route allocation tools and conflict monitoring in TMA**: Introduce ground system route allocation tools to assist the controller in managing the potentially large number of interacting routes (automatic selection of the optimum conflict-free route when triggered by a specific event). Deploy ground system situation monitoring to assist the controller in detecting and assessing the impact of deviations from clearances.
R&D
Specify near term conflict detection tools. Elaborate the appropriate data sources for the automation process. Elaborate the concept and specify the automated assistance tool for planning, preventing and detecting near term conflicts in TMA operation. Analyse the potential for the combined/complementary presentation of warnings from the ground and air conformance monitoring tools. Develop and specify the automated assistance necessary to enable real-time, optimum, conflict-free route allocation. Investigate and determine the optimum lead-time for dynamic route allocation that provides the best balance between cockpit/ controller workload and capacity, including possible airborne system modifications to support these procedures.
LoC#7 - Queue Management Tools
Integrated Queue Management Step 1: Integrate Surface Management Constraint into Arrival Management; Integrate Surface Management Constraint into Departure Management; Departure Management from Multiple Airports; Surface Management Integrated With Departure and Arrival Management.
Integrated Queue Management Step 2: Integrate arrival Management into Multiple Airports; Optimised Departure Management in the Queue Management Process; Integrate Arrival / Departure Management in the Context of Airports with Interferences (other local/regional operations).
CTA Optimisation Through Use of Datalink: All ATM partners work towards achieving Controlled Time of Arrival (CTA) through use of Datalink to optimize arrival sequence.
R&D
Evaluate the use of CTA techniques by AMAN in a mixed mode environment where not all aircraft are CTA (RTA) capable. Assess the impact on runway throughput of relative time-based

separation (ASPA S&M) versus Absolute Time based separation (RTA). Elaborate and validate the scope/boundaries of surface management/departure management/ arrival management and identification of overlaps if any. Elaborate the scope of CDM in arrival management. Develop the concept for interacting closer arrival traffic in multiple airports, within a single TMA. Elaborate and validate the scope/boundary of surface management/departure management/arrival management. Analysis of the interaction between DCB and departure management. Develop and validate the A-CDM and AMAN/DMAN integration concept. Develop and validate operational procedures. Develop and validate how Collaborative Planning will optimise network operations through applications of SWIM and constraints on the operation of AMAN, DMAN coordinated by A-CDM
LoC#8 - New Separation Modes
ASPA-S&M: Introduce enhancements to arrival sequencing through the use of ASAS in its Sequencing and Merging application i.e. Airborne Spacing Sequencing and Merging (ASPA-S&M). The flight crew ensures a time or distance based spacing from designated aircraft as stipulated in new controller instructions.
2D-PTC on Predefined Routes: Deploy Precision Trajectory Clearances on 2 Dimensions based on pre-defined 2D Routes.
R&D
Develop further the 2D precision trajectory methods and specify the expected performance requirements in respect to the potential costs. Assess the ASPA-S&M application for expected benefits versus absolute time based separation methods such as 2D Precision Trajectory Operations.”
LoC#10 - Airport Throughput, Safety and Environment
Automated Surface Movement Planning and Routing: Introduce Automated Assistance to Controller for Surface Movement Planning and Routing.
Airport Safety Nets (Pilot, Controllers and Vehicles): Introduce tools to detect potential conflicts/incursions involving mobiles (and stationary traffic) on runways, taxiways and in the apron/stand/gate areas providing alarms to controllers, pilots, and vehicle drivers together with potential resolution advice.
BTV Via Datalink: Deploy automated braking to vacate at a pre-selected runway exit coordinated with ground ATC through Datalink and based on BTV avionics that controls the

deceleration of the aircraft to a fixed speed at the selected exit.
Improved LV Operations (GBAS, EVS): Introduce GNSS / GBAS for precision approaches and EVS (Enhanced Vision System) to support final approach and surface operation Low Visibility Conditions
Enhanced Navigation for Airport Vehicles: Introduce tools that increase the airport vehicle drivers Traffic Situational Awareness (TSA) through the provision of information regarding the dynamic traffic context including status of runways , taxiways and obstacles.
Adjustment of Separation Based on Ground Wake Vortex detection: Implement dynamic Adjustment of Separations based on Real-Time Detection of Wake Vortex.
R&D
Develop and validate procedures to improve safety of operation on the airport surface through the use of alert and advisories presented to various actors (e.g. pilot, controller airport vehicle drivers). Develop and validate coordination/integration of airside operation with airport ATC operation to improve airport surface operations. Develop and validate traffic management on airport surface, including taxi routing. Develop and validate pre-selected runway exit coordination between airport ATC and aircraft, exploiting Brake To Vacate and Datalink full functionalities. Further maximize runway throughput through the development and validation of ground based wake vortex real time detection. Develop and validate precision approach and landing based on GBAS (and SBAS where appropriate for regional airfields) and/or EVS capability, maintaining operations under adverse conditions, including low visibility.

3.1.4. ATM Service Level 3

The use of free routing is extended, and a new model of airspace categories will be introduced to pave the way to the target two categories contemplated in the SESAR Concept of Operations. This is complemented by airspace organisations measures for an extensive dynamic management of En-Route and terminal airspace. ATC automation will benefit from full use of 4D shared trajectory environment, thus making it possible the implementation of a full set advanced controller tools as well as further assistance to controller in support of precision trajectory operations and effective queue management. First ASAS separation applications will be introduced. Flight deck automation will be increasingly used on the airport surface.

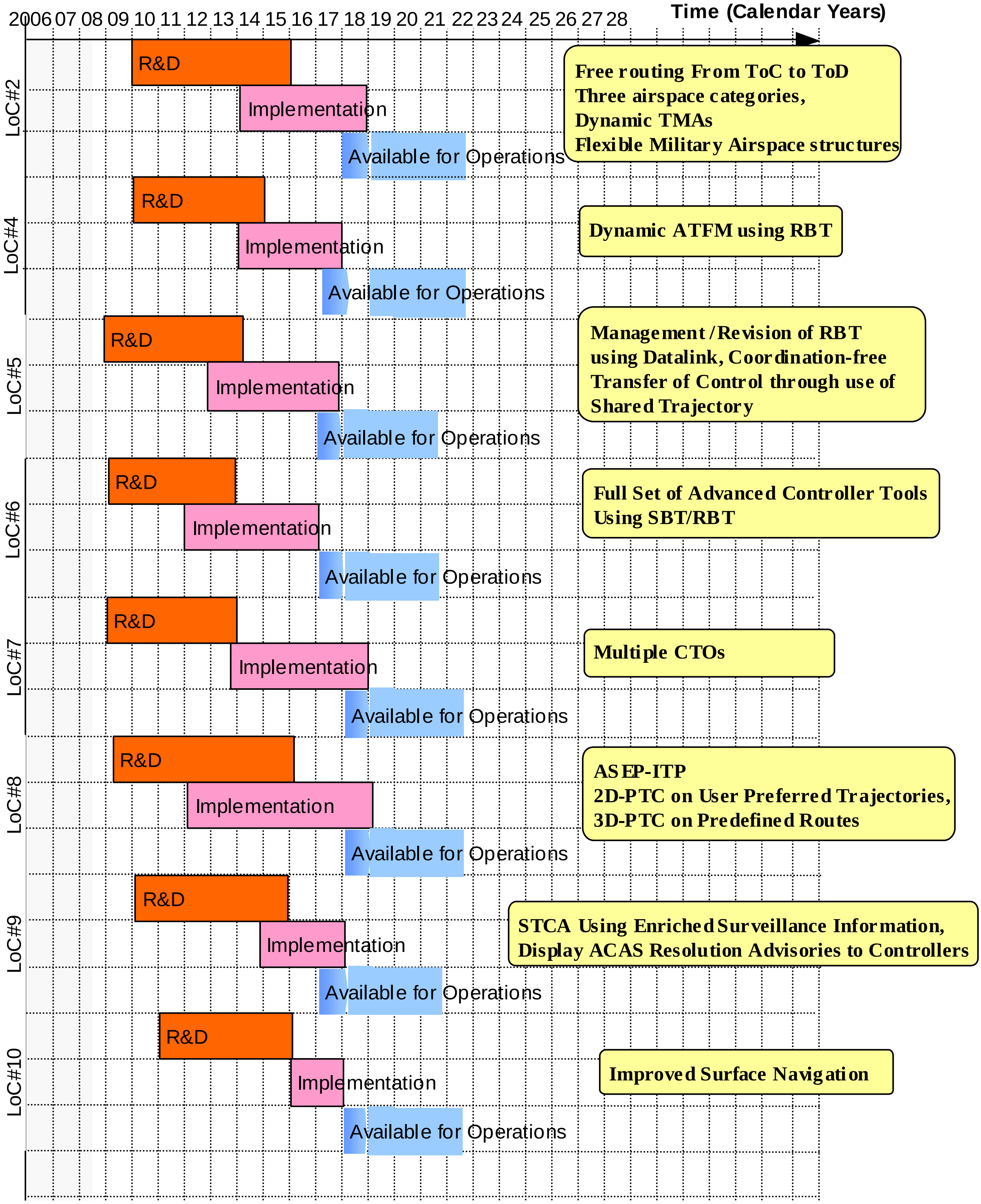


Figure 16 ATM Service Level 3

LoC#2–Moving from airspace to trajectory based operations
Free Routing from ToC to ToD: Deploy Free Routing from ToC to ToD; Maintain Pre-defined ATS Routes Only When and Where Required.

Three airspace categories: Deploy the new model of airspace based on 3 categories: N (iNtended), K (Known), U (Unknown).
Dynamic TMAs: Deploy dynamic adjustment of airspace boundaries of terminal airspace according to traffic patterns and runways in use.
Flexible Military airspace structures: Deploy Europe-wide shared use of Military Training Areas and Flexible Military Airspace Structures (FMAS) based on ad-hoc structure delineation (not covered by pre-defined structures and/or scenarios).
R&D
Validate where a fixed Route Network is still needed and the method of interfacing Free Route airspace with a fixed Route Network (including Rules and Procedures, impact on workload, economic justification, etc.) Validate rules and procedures (including economic assessment) for operations in Type N airspace with minimum aircraft equipage. Assess impact on military operations.
LoC#4 - Managing the ATM Network
Dynamic ATFM using RBT: Use 4D trajectory updates in the ATFCM process in order to optimise the network usage. Dynamic ATFCM management objective is to take benefit of the 4D trajectory updates for using capacity opportunities and for supporting the queue management and the achievement of the CTA.
R&D
Assess the integration with the Dynamic ATFCM/DCB with regard to expected performance. Elaborate the concept to establish a clear and beneficial frontier between dynamic ATFCM/DCB and complexity management. Define and validate operational process and procedures aiming at balanced and minimised constraint management mechanism including Airlines preferences.
LoC#5- Managing Business Trajectory in real time
Management Revision of RBT using Datalink: deploy digital data communication applications and services as the main means of communication even though there will remain circumstances in which clearances and instructions are issued by voice.
Coordination-free Transfer of Control Through use of Shared Trajectory: Implement coordination-free transfer of control using shared 4D trajectories, even though coordination may be required in non-nominal situations and when either time critical information or trajectory changes must be communicated.
R&D
Define ownership and information content of the shared data necessary to suppress the coordination for transfer of control. Define procedures for non-equipped aircraft and degraded mode coordination strategy.
LoC#6 - Collaborative ground and airborne decision making tools

Full Set of Advanced Controller Tools Using SBT/RBT: Deploy controller tools updated with better performance conflict detection using shared 4D trajectories (reduced uncertainty on trajectory prediction). Introduce conflict dilution by upstream action on speed (TC-SA - Trajectory Control Through Ground Based Speed Adjustments).
R&D
Analyse alternative ways to support controllers in monitoring the traffic. Validate the use of Shared 4D Trajectory as a means to detect and reduce conflicts. Validate the usability of automated support tools and conformance monitoring to prevent conflicts. Analyse the benefit, gained by reduced controller workload due to automated assistance. Elaborate the concept and analyse the usability of shared trajectories for conflict mitigation; define the data to be provided by the airspace user. Define and validate the concept of conflict dilution through the use of upstream speed management.
LoC#7 - Queue Management Tools
Multiple CTOs : Introduce Multiple Controlled times of Over-fly (CTOs) through use of Datalink. The CTOs are ATM imposed time constraints set on successive defined merging points for queue management purposes. The CTOs are computed by the ground actors on the basis of the estimated times provided by the airspace user.
R&D
Assess the management of multiple time constraints to address both airspace and airport capacity shortfalls. Assess the potential effects of the application of multiple RTA and the constraints resulting from the aircraft performance envelope, flexibility or economic profile.
LoC#8 - New Separation Modes
ASEP-ITP: Deploy separation application In-Trail Procedure (ASEP-ITP) for use En-Route in an oceanic environment as a further step toward ASAS application deployment.
2D-PTC on User Preferred Trajectories: Deploy Precision Trajectory Clearances on 2 Dimensions based on User preferred trajectories.
3D-PTC on Predefined Routes: Deploy Precision Trajectory Clearances on 3 Dimensions based on pre-defined 3D Routes.
R&D
Evaluate the ASAS S&M and ASEP-ITP applications in mixed mode of operations. Analyse compatible algorithms for ground based tools and airborne separation applications

LoC#9 - Independent Cooperative ground and airborne safety nets
STCA Using Enriched Surveillance Information: Improve ground based safety net performance using widely shared aircraft position and intent data.
Display ACAS Resolution Advisories to Controllers: Introduce Resolution Advisory (RA) downlink informing Controllers automatically when ACAS (airborne collision avoidance system) generates an RA.
R&D
Develop and validate provision to controllers of a reliable alerting system based upon all the surveillance information available.
Develop and validate the coordination of ATC and flight deck warnings as well as appropriate presentation, so that the nuisance-warning rate can be optimised. Analyse possible information overload for the controller due to the RA Downlink. Specify principles for Resolution Advisory (RA) priority over any instruction that may be triggered by ground safety nets or ATC tools.
LoC#10 - Airport Throughput, Safety and Environment
Improved Surface Navigation: Introduce tools to enhanced Trajectory Management through Flight Deck automation using advanced aircraft automated systems such as auto-brake (making it impossible for an aircraft to cross a lit stop bar) and auto-taxi (optimising speed adjustment).
R&D
Develop and validate on-board systems to support auto-brake and auto-taxi.

3.1.5. ATM Service Level 4

Service Level 4 contributes to the transition to the ATM Target Concept with full implementation of enhanced trajectory management through 3D precision clearances for user preferred trajectories and of ASAS cooperative separation applications. For airports remote tower operations are introduced and specific procedures based on synthetic vision system are defined.

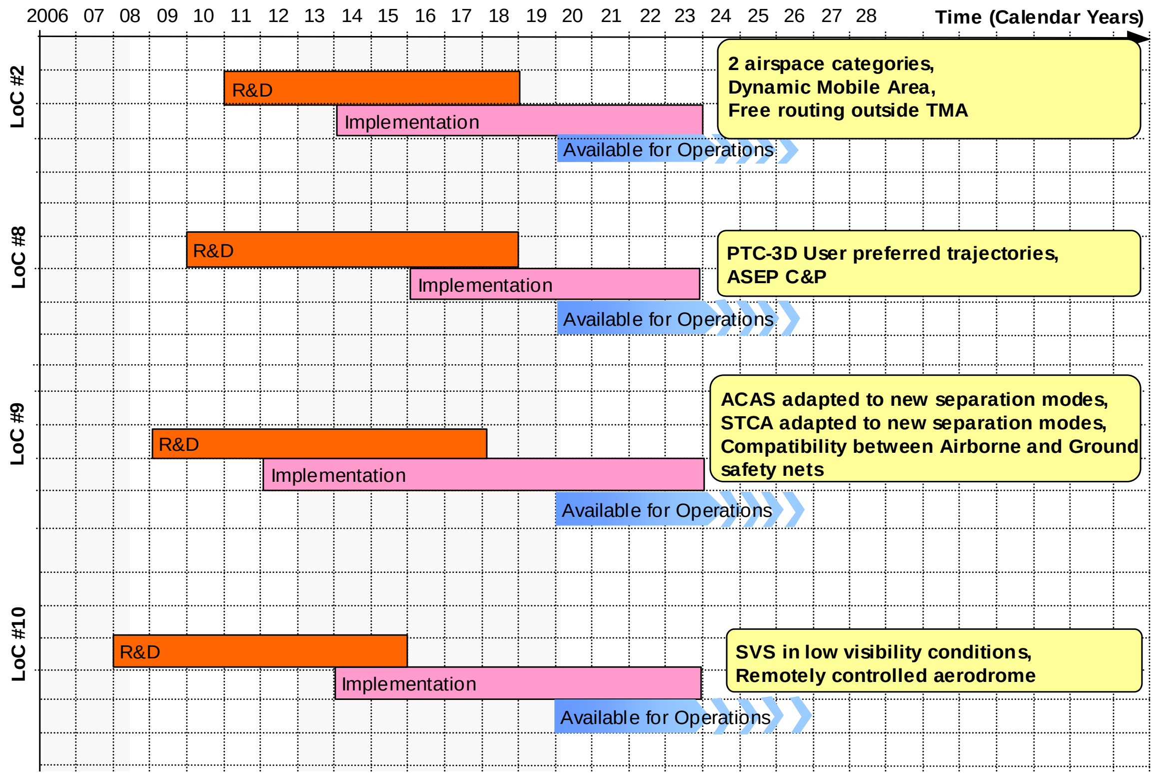


Figure 17 ATM Service Level 4

LoC #2–Moving from airspace to trajectory based operation
2 airspace categories: Remove Category K (Known) airspace.
Dynamic Mobile Area: Deploy temporary mobile airspace exclusion areas (Dynamic Mobile Areas (DMA)).
Free routing outside TMA: Deploy use of Free Routing from TMA exit to TMA entry not operating in high complexity airspace.
R&D
Provide economic justification for removing type K airspace. Assess the impact of the transition path towards reduction to 2 airspace categories. Develop and validate minimum airspace segregation requirements. Elaborate and validate the concept of Dynamic Mobile Areas (DMA) including military missions. Assess of the feasibility and benefits of the advanced flexible use of airspace (AFUA), in particular with regards to its integration with the SBT/RBT definition and revision, the dynamic DCB and the complexity management processes. Assess impact of the interaction of free routing with AMAN/DMAN sequencing, new airborne separation modes the Business/Mission Trajectory management, continuous descent and climb procedures, complexity management, capacity planning, DCB/ASM, scenario management and flight planning processes.

LoC #8–New Separation Modes
3D-PTC User preferred trajectories: Deploy 3D Precision Trajectory Clearances (3D-PTC) for Aircraft flying User Preferred Trajectories (Dynamically applied 3D routes/profiles).
ASEP C&P: Deploy delegation of the separation by the controller to an aircraft for Crossing and Passing manoeuvres relative to designated target aircraft.
R&D
Develop and validate 3D Precision Trajectory (3D-PTC) separation methods. Develop and validate the operating concept for the ASEP C&P and Self Separation applications in mixed mode of operations. In particular, evaluate the impact of impact RNP/RCP/RSP on the separation minima (strategic or tactical).
LoC #9–Cooperative ground and airborne safety nets
ACAS adapted to new Separation modes: Adapt the ACAS function to ensure it keeps playing efficiently its role of safety net in the context of new separation modes and lower separation minima.
STCA adapted to new Separation modes: Adapt the STCA function to new separation modes in particular if lower separation minima is considered.
Compatibility between Airborne and Ground safety nets: Introduce improved compatibility between airborne and ground safety nets. Although ACAS and STCA are and need to stay independent at functional level there is a need for better procedures in order to avoid inconsistent collision detection and resolution.
R&D
Enhance ACAS function so that it can recognise the new separation modes and any false alarms can be minimised, in particular when lower separation minima is considered as a result of the introduction of the delegation of the role of separator, because aircraft may fly in close proximity to each other with geometries that would trigger ACAS as we know it today. Enhance STCA function so that it is able to recognise the new separation modes and avoid triggering false alarms and hence optimising the nuisance alarm rate for the controller's benefit. Analyse the impact of ACAS on ATC systems. Improve means to avoid inconsistent collision detection and solution by ACAS and STCA. Develop and validate a prioritisation process, which shall be followed by airborne and ground safety nets when operating together.
LoC #10–Airport Throughput, Safety and Environment
SVS in low visibility conditions: Introduce a synthetic vision system in the cockpit, which provides the pilot with a synthetic/graphical view of the environment, for use in low visibility conditions, using terrain imagery and position/attitude information.
Remotely controlled aerodrome: Deploy remotely provided aerodrome control service.

R&D
Develop and validate the context of remote TWR application in respect to the traffic levels. Develop rules and procedures for the use of remotely operated aerodrome ATC. Assess the level of traffic that can be safely managed under these circumstances. Depending on early results from the R&D and specific regional needs, early implementation (in the 2013 –2015 timeframe) might be achievable. Develop procedures for synthetic vision (SVS) based operations for use in low visibility conditions.

3.1.6. ATM Service Level 5

Main features of Service Level 5 will be the implementation of 4D Precision Trajectory Clearances and the introduction of ASAS Self-Separation in a mixed mode environment. Those changes require extensive feasibility studies and will be completed as result of innovative research and as part of the Master Plan maintenance process.

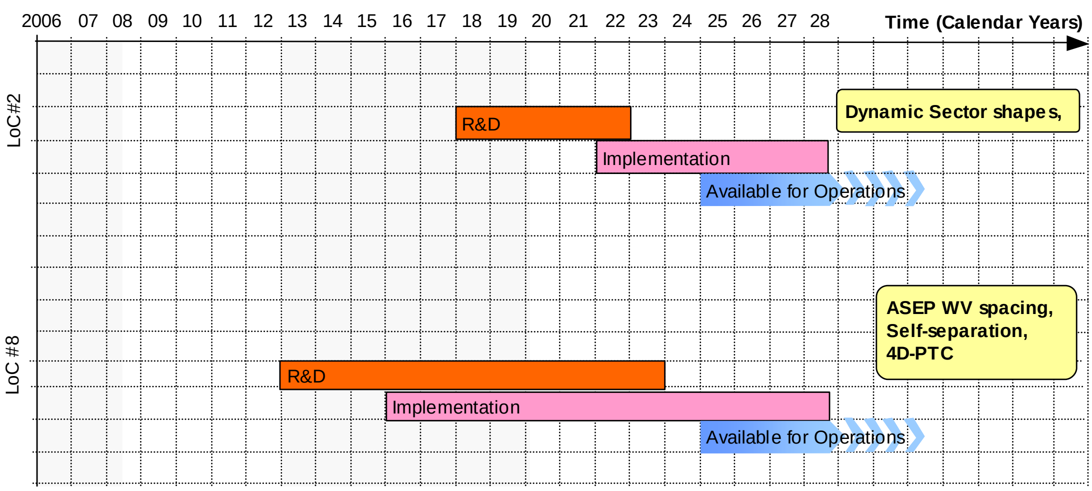


Figure 18 ATM Service Level 5

LoC#2–Moving from Airspace to Trajectory Based Operations
Dynamic Sector shapes: ATC sector shapes and volumes are adapted in real-time to respond to dynamic changes in traffic patterns and/or short-term changes in users' intentions.
R&D
Elaborate the concepts of Dynamic Sectors and Dynamic TMAs in respect of: the operational contexts (airspace, complexity level, traffic mix…) in which they apply. Assess the integration and impact on capacity planning, DCB/ASM, scenario management and flight planning processes.
LoC#8–New Separation Mode
ASEP WV spacing: Deploy Self-Adjustment of spacing depending on Wake Vortices. The

spacing is adjusted dynamically by the pilot based on the actual position of the vortex of the predecessor.
Self-separation: Deploy the delegation of the separation by the controller between an aircraft and all the other aircraft in mixed-mode environment through new air broadcast and reception of trajectory data and new onboard conflict detection and resolution functions.
4D-PTC: Deploy the 4D-PTC using longitudinal navigation performance management from the aircraft.
R&D
Elaborate the concepts of A/A services, including exchange of weather hazards and Wake-Vortexes information. Develop and validate 4D-PTC with extended clearance. This should identify the trajectory management requirements and the separation minima applicable to 4D-PTC with extended clearance and should take into account the improved RNP capability of aircraft. Compare alternative means of separation management like airborne self management; cooperative self-separation for business jet in low density high altitude airspace (e.g. above FL410) should be started as early as possible to validate the self-separation concept. Investigate potential Human Factor impact of the mixed mode operation on both pilots and controllers.

3.2. Supporting Changes

3.2.1. Evolution towards System Wide Information Management

Historically, the focus of attention has primarily been on how to improve (algorithms, automated tools and procedures for) decision making in the various functional categories e.g. airspace management, flow and capacity management, separation assurance, sequencing and metering etc. — whereas the purpose of *System Wide Information Management* is complementary. It focuses on improving the information supply chain to and from the above mentioned decision making to improve ATM performance. More details on the relationship between SWIM and ATM Performance are provided in Annex **Error! Reference source not found.**.

3.2.1.1. Principles used for Building the SWIM Deployment Sequence

The deployment sequence of SWIM is defined taking the following considerations into account:

- SWIM has been recognised as an essential enabler of ATM applications, the principles of which are also applied in, and supplied by, other industries. Technologies enabling SWIM capabilities required by ATM are available. SWIM as a methodology of sharing information can apply to all ATM capability and service levels. In this context "SWIM Capability Level" relates in some cases to an extension of geographical/spatial availability, although different ATM Service Levels may equally need more advanced and/or widespread implementation of SWIM.

- SWIM is an enabler of end-user applications needed in ATM. It is not in itself an ATM end-user application. The concept of SWIM will make information more commonly available and consequently allow its usage by end-user applications. This will further allow not to constrain the implementation of end-user applications by the otherwise necessary full deployment of the relevant airborne and ground capability and to provide benefits at an earlier stage;

- SWIM creates the conditions for advanced end-user applications based on extensive information sharing and the capability of finding the most appropriate source of information;

- For the deployment of SWIM an approach has been selected ensuring that benefits start to accrue at the earliest possible time: this is achieved by migrating simpler end-user applications first. The deployment of SWIM is not dependent on the deployment of ATM changes. SWIM benefits are available even in a largely legacy environment;

- SWIM deployment will require creation of a new Stakeholder role, the Regional SWIM Manager, responsible for the overall SWIM management in the distributed SWIM environment (see section **Error! Reference source not found.**). In addition each Stakeholder is responsible for the adaptation of their systems (e.g. procedures, technical, etc.) and operations in this SWIM distributed environment.

Deployment towards SWIM is split into SWIM Capability Levels (see Figure 19) that are defined for achieving early benefits and the most cost efficient building up of SWIM capability taking into account the need to lead the overall ATM evolution and also to make sure that some benefits can even be gained in the legacy environment:

- SWIM Capability Level 1 with a planned IOC date of 2009;

- SWIM Capability Level 2 with a planned IOC date of 2013;

- SWIM Capability Level 3 with a planned IOC date of 2017.

Each SWIM Capability Level is described in terms of four top-level aspects (illustrated with non-exhaustive types of enablers that would need to be defined, but that are considered essential if SESAR aims are to be achieved in a cost effective way):

- “Institutional” covering the areas of Regulation, Licensing, Liability, and Ownership;

- “Network” in this context refers to the data networks and not the ATM network;

- “Systems” include both ground and airborne systems:

- “End-user Applications” such as Controllers tools, Airborne Decision Making aids, NOPLA.

3.2.1.2. <u>The SWIM Deployment Plan</u>

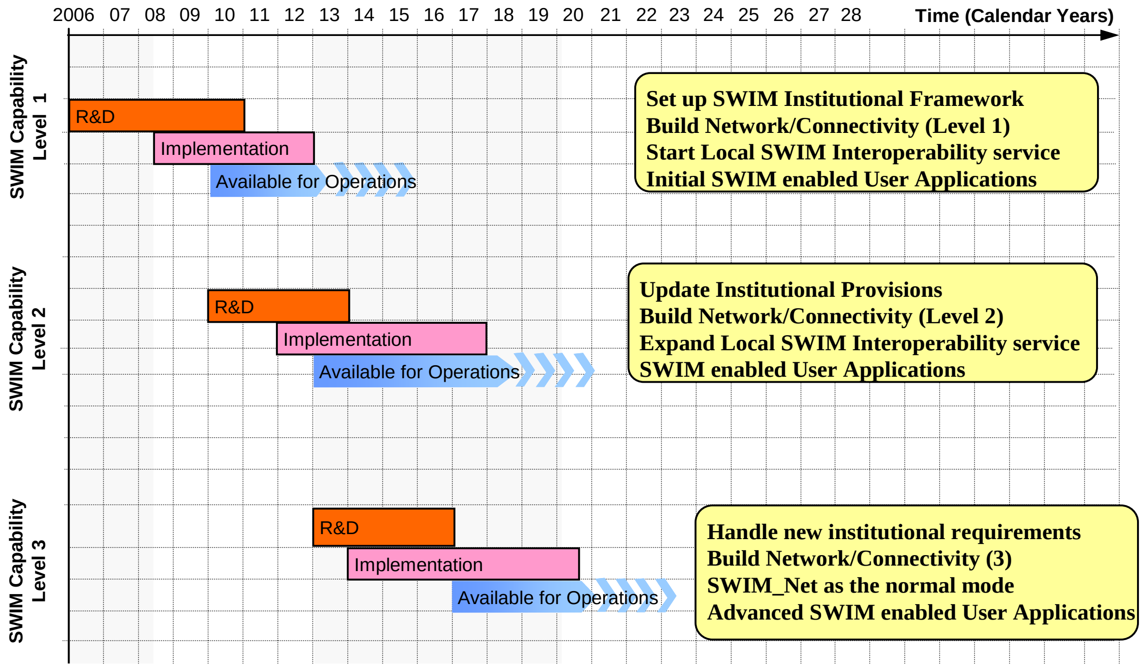


Figure 19 Evolution towards SWIM

SWIM Capability Level 1 Deployment
Develop SWIM Institutional aspects: a set of decisions and rules, which enable the necessary amendments to ICAO and European provisions (e.g. Annex 3, 10, 11, 15, Doc. 4444, 7030 etc.) on which SWIM has an impact to be initiated and carried to approval. The following actions should be undertaken: P1.I1 - Define new rules and trigger amendments to existing rules; P1.I2 - Identify standards to be used and new standards to be defined (including exchange formats, etc.), develop standards; P1.I3 - Agree SWIM security policy; P1.I4 - Establish EUR SWIM Management; P1.I5 - Agree legacy service provision arrangements; P1.I6 - Identify and organise provider categories; P1.I7 - Start issuing licences; P1.I8 - Organise charging (in accordance with established principles). This includes extending the scope of aeronautical information and integrating Meteo information in the extended scope.
Build Network / Connectivity (SWIM Capability Level 1) P1.N1 - Identify common services and assignments. Ensure compatibility with other

SWIM-like environments; P1.N2 - Select network providers (on the basis of quick start need), build initial connectivity; P1.N3 - Promulgate network side standards for “Local SWIM Connectivity Service”; P1.N4 - Start deploying mobile connectivity.
Start Local SWIM Interoperability service in stakeholders’ Systems P1.S1 - Start implementing “Local SWIM Connectivity Service” in partner systems or identify and use existing capability. P1.S2 - Implement the common ATM information reference model that will enable the implementation of SWIM information exchange.
Initial SWIM-enabled User Applications P1.A1 - Transition Airport Collaborative Decision Making (A-CDM) applications from message based to data based operation; P1.A2 - Implement flight data/flight plan input applications (e.g. for GA and military); P1.A3 - Implement applications for accessing meteorological information (e.g. Aeronautical and Weather Information Provision); P1.A4 - Update Flight Data Processing applications to accept shared trajectory information from outside sources (e.g. Flight Operations Centre or later on-board Flight Management); P1.A5 - Implement first version of the interactive Network Operations Planner (NOPLA); P1.A6 - Update airspace user applications to enable use of NOPLA; P1.A7 – Improve Flight Data Consistency and Interoperability; P1.A8 – Continue to evolve from Aeronautical Information Service to Aeronautical Information Management.
R&D
Develop and validate common information exchange models (e.g. ATFCM, Meteo, flight data). Develop and validate human factors principles for the exploitation and interpretation of the information being exchanged. Develop and validate SWIM infrastructure and services through local prototypes to assess interoperability and performance aspects, including requirements for CNS

technologies.

SWIM Capability Level 2 Deployment
Update Institutional Provisions P2.I1 – Update institutional provisions based on P1 experience.
Build Network / Connectivity (SWIM Capability Level 2) P2.N1 – Implement high speed connectivity for all partners; P2.N2 – Implement mobile connectivity at all locations when needed.
Expand Local SWIM Interoperability service P2.S1 – Implement "Local SWIM Connectivity Service" in all partner systems.
SWIM-enabled User Applications P2.A1 - Timing of some applications in SWIM Capability Level 2 will depend on the ATM implementation schedule; P2.A.2 – Implement Controller tools to use *shared* 4D trajectory data; P2.A3 - Implement En-route ATC sub-systems to use *shared* RBT and PT and *share* constraints and clearances.
R&D
Validate use of aircraft derived data including weather data to enhance ground trajectory functions and safety nets. Identify the detailed operational requirements for new airport Datalink. Identify the detailed operational requirements for ADS-C and CPDCL to support European operation (e.g. Meteo and trajectory). Define and validate the CDM processes and the communication mechanisms to enable participation of ATM performance partners in all phases of flight. Develop and validate the visualisation tools covering all stakeholder information access and performance needs to operate NOP.

SWIM Capability Level 3 Deployment
Handle Institutional Requirements P3. I1 – By this time, all the institutional details concerning SWIM should be well

established and functional. Eventual new requirements are handled as part of the routine operation.
Build Network / Connectivity (SWIM Capability Level 3) P3.N1 – All the elements of the information network supporting SWIM must be in place with only the air/ground segment still not fully implemented everywhere. However, adding new nodes in the form of additional aircraft (or in fact any other user) is a routine operation.
Expand Local SWIM Interoperability service P3.S1 – Local SWIM Connectivity Service has been implemented in all existing systems (e.g. e.g. AGDLGMS on the ground side and corresponding Aircraft functionality) and all new systems contain this element as a baseline feature. Operating using the information network supporting SWIM is the normal mode for all systems.
SWIM-enabled User Applications P3.A1 - SWIM is now used to support even the most advanced ATM applications, even real time surveillance applications. It is ATM requirements that drive the implementation of the ATM applications with information management not forming a limitation of any kind.
SWIM Capability Level 3 R&D
None required

Institutional Roadmaps

This section contains the roadmaps for the supporting aspects that will enable operational evolutions and stakeholder deployment plans. These activities have to be fully synchronised with the associated SWIM Capability Levels, ATM Service Levels and ATM Capability Levels.

Legislation/Regulation

This Legislation/Regulation roadmap covers the improvements with regards Legislation/Regulation to support the implementation of the ATM Target Concept. It also includes the Legislation/Regulation activities related to each of the other Supporting Activities.

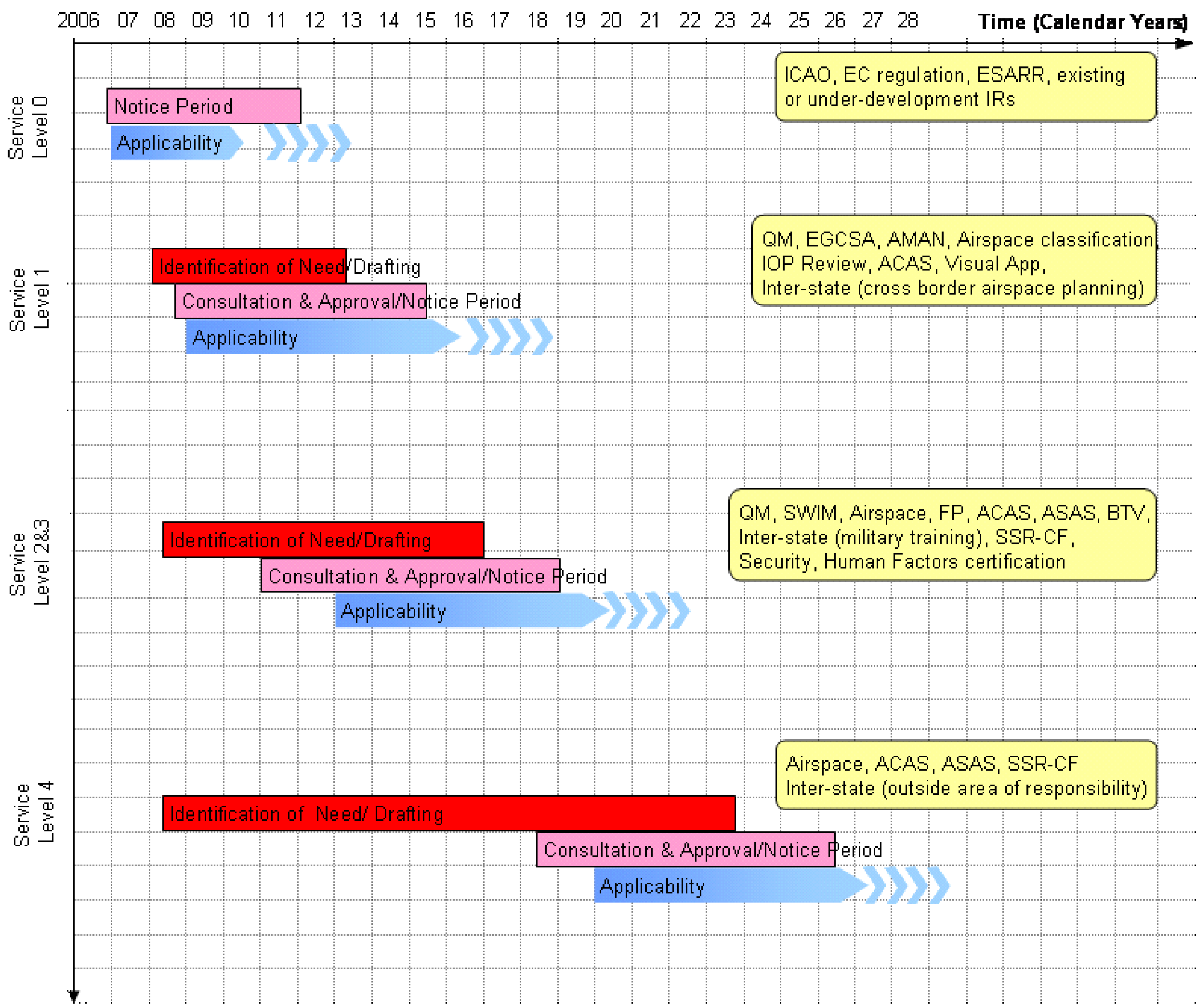


Figure 20 Legislation / Regulation roadmap

Service Level 0&1
Continued development of current draft **EU legislative** proposals.

Publish revised Annex 1 of the **Interoperability Regulation** following review for compatibility with the SESAR Reference Architecture. Develop and publish any further **EU legislation** required (following an identification of needs process) to address current safety regulatory shortcomings and to support the implementation of Operational Improvements, noting that it is unlikely that any proposals for new European legislation which is not already under development could be taken to publication in time for implementation before the end of Service Level 1
Following "identification of needs" process, amend **national legislation** in response to new EU legislation. If required, where concept developments are not enforced through EU legislation, amend national legislation to support SESAR deployment. Perform **regulatory oversight** on changes to the ATM system. Includes EASA certification of airborne equipment and NSA oversight and approval of ANS Providers/Airports. Appropriate standards (ICAO, EUROCONTROL, EUROCAE, ESO) would be an input into regulatory approval.
Publish **inter-state** agreements (cross border airspace planning).
Identification of needs for Service Level 1
Review Annex 1 of the Interoperability Regulation for compatibility with the SESAR Reference Architecture. Investigate how to establish institutional, legal, financial and liability issues related to Meteo service provision. A legislative and regulatory impact assessment in line with EC guidelines (SEC(2005)791) will be conducted, covering the full life cycle of all legislative proposals for Service Level 1. Such impact assessment will be used to consider and to balance the imperatives of Safety, Economic, Efficiency, and Environmental impacts in particular (along with the 11 ICAO KPAs) with synergies and trade-offs in a sustainability perspective and to facilitate decision-making/buy-in by all stakeholders at all stages. ICAO and other proposed standards will be key inputs into this process. Initial screening suggests that legislative/regulatory actions are expected to be required for: Queue Management **(QM) (**Extended AMAN**,** Synchronised DMAN, integrated AMAN/DMAN**), Interop (IOP) Regulation Annex A, Enhanced Ground Controller Situation Awareness (EGCSA)** in all weather conditions at airports and using Shared Trajectory**, Airspace (**below FL195**). ACAS (**ATSAW)**, ASAS** (Manually controlled S&M)**, Visual** contact **App**roaches for IFR traffic**.**

Service Level 2
Develop and publish any further **EU legislation** required following the "identification of needs" process.

National activities as for Service Level 0/1.
Publish **inter-state** agreements (shared use of military training areas).
Operate the SESAR Safety Regulatory-Coordination Function (**SSR-CF**) for Service Level 2 in a clarified ATM safety regulatory framework and process, in cooperation with EASA.
Implement a **Security** regulatory framework.
Implement framework and process for **certification of Human Factors** of integrated air/ground systems, in cooperation with EASA.
Identification of needs for Service Level 2
Develop a framework and process for certification of integrated air/ground systems (including Human Factor Aspects), in support to EASA. Update SWIM Institutional Provision based on previous service level experience. Review the output of other R&D activities to determine any new potential legal implications (e.g. changing roles and responsibilities, such as those relating to ASAS applications and automated BTV). Investigate options to change the economic regulatory framework to facilitate the use of incentives to support the implementation of OIs. A legislative and regulatory impact assessment (including safety regulatory baseline and framework) in line with EC guidelines (SEC (2005)791) will be implemented and cover the full life cycle of all legislative proposals for Service Level 2. Such impact assessment will be used to consider and to balance the imperatives of Safety, Economic, Efficiency, and Environmental impacts in particular (along with the 11 ICAO KPAs) with synergies and trade-offs in a sustainability perspective and to facilitate decision-making/buy-in by all stakeholders at all stages. Initial screening suggests that legislative/regulatory actions are currently expected to be required for: Queue Management **(QM)** (multiple airport AMAN/DMAN, AMAN/SMAN, DMAN/SMAN, optimised DMAN, CTA), **SWIM** (Datalink services, Institutional framework: security, Governance and Access Rules), ASPA-S&M, **Airspace**, **Flight Plan** (**FP**). **ACAS** RA downlink**,** Brake To Vacate **(BTV)**. Establish SSR-CF and define SESAR JU interface arrangements with SSR-CF, in support of the "identification of needs" process. Clarify responsibilities and accountabilities of the different stakeholders involved in safety regulation.

Service Level 3

Develop and publish any further **EU legislation** required following the "identification of needs" process
National activities as for Service Level 0/1
Operate the SESAR Safety Regulatory-Coordination Function (**SSR-CF**) for Service Level 3 in a clarified ATM safety regulatory framework and process, consistent with EASA.
Identification of needs for Service Level 3
Review the output of other R&D activities to determine any new potential legal implications (e.g. changing roles and responsibilities, such as those relating to ASAS applications). Investigate options to change the economic regulatory framework to facilitate the use of incentives to support the implementation of OIs. A legislative and regulatory impact assessment (including safety regulatory baseline and framework) in line with EC guidelines (SEC (2005)791) will be implemented and cover the full life cycle of all legislative proposals for Service Level 3. Such impact assessment will be used to consider and to balance the imperatives of Safety, Economic, Efficiency, and Environmental impacts in particular (along with the 11 ICAO KPAs) with synergies and trade-offs in a sustainability perspective and to facilitate decision-making/buy-in by all stakeholders at all stages. Initial screening suggests that legislative/regulatory actions are currently expected to be required for: Queue Management **(QM)** (Multi-CTO), **ASAS** (ASEP-ITP). Establish SSR-CF and define SESAR JU interface arrangements with SSR-CF, in support of the "identification of needs" process for service level 3. Clarify responsibilities and accountabilities of the different stakeholders involved in safety regulation.

Service Level 4
Develop and publish any further **EU legislation** required following the "identification of needs" process.
National activities as for Service Level 0/1.
Operate the SESAR Safety Regulatory-Coordination Function (**SSR-CF**) for Service Level 4 in a clarified ATM safety regulatory framework and process, consistent with EASA.
Publish **Inter-state** agreements (service provision outside area of responsibility).

Identification of needs for Service Level 4
Review the changing responsibility and liability issues associated with new ways of working (e.g. ASAS self separation). Review the output of other R&D activities to determine any new potential legal implications. A legislative and regulatory impact assessment (including safety regulatory baseline and framework) in line with EC guidelines (SEC(2005)791) will be implemented and cover the full life cycle of all legislative proposals for Service Level 4. Such impact assessment will be used to consider and to balance the imperatives of Safety, Economic, Efficiency, and Environmental impacts in particular (along with the 11 ICAO KPAs) with synergies and trade-offs in a sustainability perspective and to facilitate decision-making/buy-in by all stakeholders at all stages. Initial screening suggests that legislative/regulatory actions are currently expected to be required for: **ASAS** (ASEP-C&P, ASEP WV spacing, Self separation, 4D contracts), **Airspace, ACAS** (new separation modes) Establish SSR-CF for service level 4. Clarify responsibilities and accountabilities of the different stakeholders involved in safety regulation.