SESAR

THE ROADMAP FOR SUSTAINABLE AIR TRAFFIC MANAGEMENT

# European ATM Master Plan

EDITION 2

## EXECUTIVE SUMMARY - AIR NAVIGATION SERVICE PROVIDERS

OCTOBER 2012

Updated with SESAR's first developments

founding members

EUROPEAN UNION

EUROCONTROL

THE ROADMAP FOR SUSTAINABLE AIR TRAFFIC MANAGEMENT

# European ATM Master Plan

EDITION 2

## EXECUTIVE SUMMARY - AIR NAVIGATION SERVICE PROVIDERS

Updated with SESAR's first developments

OCTOBER 2012

founding members

EUROPEAN UNION

EUROCONTROL

# EXECUTIVE SUMMARY




# EXECUTIVE SUMMARY

**INTRODUCTION:**
**What is the European ATM Master Plan?**

Within the Single European Sky (SES) initiative, the European ATM Master Plan (Master Plan) is the agreed roadmap driving the modernisation of the Air Traffic Management system and connecting SESAR[1] research and development with deployment. It is the key tool for SESAR deployment, providing the basis for timely, coordinated and efficient deployment of new technologies and procedures.

The first edition of the European ATM Master Plan was endorsed on 30 March 2009 and adopted on 12 June 2009 by the SESAR Joint Undertaking (SJU) which is responsible through EU Council Regulation for the maintenance of the Master Plan.

This 2012 edition of the Master Plan embeds major updates which mark a clear distinction compared with the initial document:

- it takes benefit of the first results achieved by the SESAR Programme to prioritise a set of essential changes that either provides significant performance benefits and/or forms a pre-requisite towards the implementation of the target concept;
- it prepares for the SESAR deployment phase, developing stakeholder roadmaps which provide a temporal view (up to 2030) of the ATM Technology Changes required and updating the Business View, providing a basis for timely and synchronised deployments;
- it promotes and ensures interoperability at global level, in particular in the context of ICAO.

**PERFORMANCE VIEW:**
**What are the performance needs and targets?**

Air traffic has not evolved in line with the forecast underpinning the 1st edition of the Master Plan. Although there are still considerable uncertainties regarding the near future, the consensus economic forecasts are for a resumption of near-trend growth in the medium-term and it is on this basis that the Master Plan is developed.

The proposed SES strategic performance objectives presented in this document provide a practical expression of the SES high-level political goals, in terms of measurable Key Performance Indicators (KPIs), and are based on the best current estimation of traffic growth. The SES performance-driven approach focuses on the four Key Performance Areas (KPAs) of environment, cost-efficiency, safety, and capacity/quality of service.

SESAR contributes to meeting these SES strategic performance objectives and drives R&D activities towards the achievement of a set of validation targets.

1 As part of the Single European Sky initiative, SESAR (Single European Sky ATM Research) represents its technological dimension. It will help create a “paradigm shift”, supported by state-of-the-art and innovative technology. The SESAR programme will give Europe a high-performance air traffic management infrastructure which will enable the safe and environmentally friendly development of air transport.

**DEPLOYMENT VIEW:**
**What is required to be deployed to achieve performance needs and targets?**

The transition towards the target Operational Concept follows three complementary Steps. Step 1, Time-based Operations is the focus of the current Master Plan and progresses through Step 2, Trajectory-based Operations to Step 3, Performance-based Operations. Step 1 starts from the Deployment Baseline consisting of operational and technical solutions that have successfully completed the R&D phase and have been implemented or are being implemented.

As shown in the figure, the Master Plan identifies essential operational changes for Step 1 which should establish the foundations for the subsequent steps while responding to the performance needs. These changes are grouped in 6 Key Features that describe the main strategic orientations and are the means to deliver performance to achieve the performance goals. The civil-military dimension is an integral part of these operational changes.

**How and when will it be deployed?**

The operational changes are enabled through improvements to technical systems, procedures, human factors and institutional changes supported by standardisation and regulation.

The human element remains pivotal to the success of SESAR, and in ensuring that SESAR delivers the benefits expected in environment, cost efficiency, safety, and capacity. The SESAR concept of operations will drive changes to the procedures being used by all stakeholders, and in particular will start to modify responsibilities between technology, controllers and flight crew. This needs to be supported by relevant regulatory changes.

The Master Plan includes roadmaps of the identified changes per stakeholder group ensuring that their deployment is planned in a performance driven and synchronised way (e.g. between ground and air deployments) to maximise the benefits achieved.

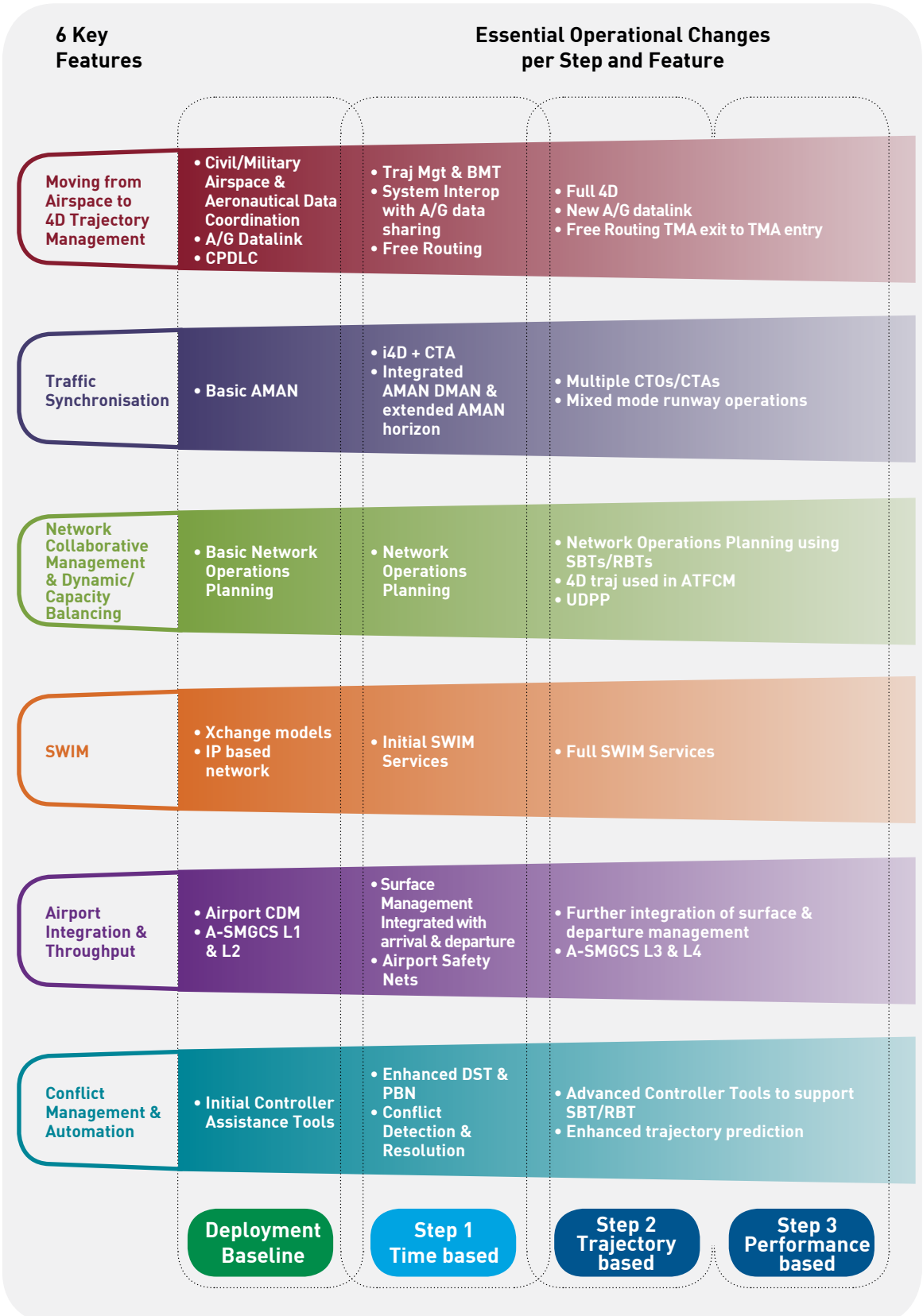
**BUSINESS VIEW:**
**What are the costs and the benefits?**

The SESAR programme is a key contributor to the achievement of the Single European Transport Area[2] and enables smart economic growth for Europe. SESAR will provide an effective remedy to air transport capacity bottlenecks, fills gaps in the air traffic management system, enables significant reduction of $CO_2$ emissions, increases safety, and reduces overall costs. SESAR benefits all European stakeholders and extends beyond the air transport industry.

The Business View is a high level view, which does not replace the need for dedicated stakeholder business cases and cost benefit analyses. Mature solutions, supported by business cases containing a clear quantification of the deployment performance expectations will be the outcome of validation. Pending the validation of the assumed benefits, the approach has been to consider the monetisation of the performance validation targets as a first indication of potential benefits.

Investments required to implement the changes described in the Master Plan for all 3 Steps have been estimated to be between 23 and 32 Bn€ for civil stakeholders for the period 2014-2030. These include investments for Deployment Baseline, Step 1 and Step 2. While estimates of the investment required in the shorter term (Deployment Baseline and Step 1) have been recently updated, the costs for Step 2 correspond to estimates provided during the Definition phase. The investment cost for Step 2 will be reviewed once the technologies and functions supporting this step mature. No further cost assessments have been performed by the Military, earlier estimated to reach 7 Bn€. For Scheduled Airlines, taking into account the investments required for Step 1, SESAR is estimated to create a direct net positive impact of at least 5 Bn€ in the 2014-2030 period provided timely and synchronised deployment is achieved. To this value it is necessary to add other benefits such as those from delay avoidance and flight cancellation savings. In addition, Deployment Baseline and Step 1 will establish the basis on which Steps 2 & 3 will be deployed and thus bring further benefits.

2 White Paper 2011: Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system – EC COM(2011) 144 final


6 Key Features
Essential Operational Changes per Step and Feature
Moving from Airspace to 4D Trajectory Management
• Civil/Military Airspace & Aeronautical Data Coordination
• A/G Datalink
• CPDLC
• Traj Mgt & BMT
• System Interop with A/G data sharing
• Free Routing
• Full 4D
• New A/G datalink
• Free Routing TMA exit to TMA entry
Traffic Synchronisation
• Basic AMAN
• i4D + CTA
• Integrated AMAN DMAN & extended AMAN horizon
• Multiple CTOs/CTAs
• Mixed mode runway operations
Network Collaborative Management & Dynamic/ Capacity Balancing
• Basic Network Operations Planning
• Network Operations Planning
• Network Operations Planning using SBTs/RBTs
• 4D traj used in ATFCM
• UDPP
SWIM
• Xchange models
• IP based network
• Initial SWIM Services
• Full SWIM Services
Airport Integration & Throughput
• Airport CDM
• A-SMGCS L1 & L2
• Surface Management Integrated with arrival & departure
• Airport Safety Nets
• Further integration of surface & departure management
• A-SMGCS L3 & L4
Conflict Management & Automation
• Initial Controller Assistance Tools
• Enhanced DST & PBN
• Conflict Detection & Resolution
• Advanced Controller Tools to support SBT/RBT
• Enhanced trajectory prediction
Deployment Baseline
Step 1 Time based
Step 2 Trajectory based
Step 3 Performance based

The investment figures should be taken with caution as underlying figures had a very high variance, in particular for Airport Operators and Regional Airlines. They may not be applicable to all sub-categories of stakeholders. In addition, whereas for airborne investments, up-to-date cost estimates from manufacturing industry were available for the ANSP investments this was not the case. There is a need for more detailed analysis of the cost of SESAR to ANSPs and of its integration in ANSP investment cycles. Cost inputs from the manufacturing ground industry will be important for this analysis.

The time lag between the upfront SESAR investments by the different stakeholders and the full realisation of benefits will present a risk to SESAR deployment. The risk is to create a last-mover advantage whereby each stakeholder would wait until all others have proceeded with SESAR investments. This should be addressed through the effective implementation of SESAR Deployment governance and incentive mechanisms.

This second edition of the European ATM Master Plan outlines the essential operational changes and technological changes that are required to contribute to achieving the SES performance objectives, preparing the Master Plan to become a key tool for SESAR deployment and providing the basis for timely and coordinated deployment of the efficient technologies and procedures.

The Master Plan provides the best actualised view on the products, technologies and operational procedures, which can be further industrialised and deployed in order to satisfy the needs of the European citizens.

## ANSPs Perspective

The essential operational changes identified in this edition mainly result from expert judgment and constitute an initial basis from which to prepare for the deployment phase and accordingly detailed stakeholders' roadmaps are included which provide a temporal view of the ATM Technology Changes as a basis for timely and synchronised deployments.

At ANSP level the main objective of the Master Plan is that it becomes the tool that includes the portfolio of operational changes to be used by ANSP Planning Directors to decide on what investments should be made to comply with SES requirements (i.e. Performance Scheme, Charging Scheme and Interoperability Regulations).

**ANSP Needs and Network Needs**

ANSPs look to SESAR as one of the main means of delivering the cost efficiency, safety, capacity and environmental benefits with which they are targeted in the European reference performance period. Therefore the Master Plan should present solutions in such a way that business cases (cost of putting into operation and performance improvement expectations) can be derived both at global pan-European level and at local level, facilitating decisions on what, where and when to invest on the basis of the how much and the why. In order to conduct such investment decision making a more clear mapping should be provided in the next Master Plan update between the selection of essential improvements and the performance objectives that could change according to the economical situation evolution (e.g. this Master Plan update has been driven by the capacity needs while the economical situation no longer puts more capacity as the highest priority performance area and therefore ANSP priorities).

Efficient synchronisation of investment in airborne and ground infrastructure equipage is required, which in turn entails coherent action between ANSPs, airspace users and airports. This is the reason why the Master Plan includes roadmaps per stakeholder group ensuring that their deployment is planned in a performance driven and fully synchronised manner (e.g. between ground and air deployments).

**DEPLOYMENT VIEW**

The deployment plan needs to recognise the need for a minimum level of equipage both in the air and on the ground before benefits can be reaped. Such key elements to consolidate deployment plans are not yet available. Therefore, if it is necessary for stakeholders to invest well before benefits can be achieved, or should the consequence of the investment be 'stranded assets', financial incentives are needed.

Among the set of essential operational changes shown in Master Plan 5 are of particular interest to ANSPs due to both the ANSPs responsibility for their deployment and the contribution they make to the performance needs defined in this Master Plan:

- **I4D + CTA:** The aircraft capability to comply with a requirement to reach a specific trajectory point at a contracted time. It will improve the capacity due to a better sequencing of arriving flights and reduction of the controller workload.
- **Integrated AMAN/DMAN and Extended AMAN Horizon:** The use of extended AMAN horizon consists of the coordination between a TMA ATSU and En-route ATSU to delay or accelerate a given flight in its en-route phase to synchronise its arrival at a TMA entry point. Hence capacity is increased due to a greater runway throughput, an optimised usage of terminal airspace and through dynamic runway rebalancing to better accommodate arrival and departure patterns
- **Trajectory Management & Business Mission Trajectory:** A trajectory representing the business intentions of the airspace users and integrating ATM and airport constraints is negotiated, this is the Shared Business Trajectory or Mission Trajectory for military users. When the flight is ready for departure, it becomes the Reference Business Trajectory, that a user agrees to fly and the ANSP and airport agrees to facilitate. It can improve both capacity and flight efficiency through more reliable planning based upon the sharing of an accurate flight profile and a better anticipation and management of the various ATM system constraints, allowing more optimised flight trajectories and profiles.
- **System Interoperability with Air/Ground Data Sharing:** It will facilitate ground/ground and air/ground exchanges between the various ATM systems or constituents. The main benefit will be a better use of available capacity within the ATM network.
- **Enhanced Decision Support Tools & Performance Based Navigation:** The Enhanced Decision Support tools associated with the Performance Based Navigation (PBN) capabilities will offer a greater set of routing possibilities that could reduce potential congestion on trunk routes and at busy crossing points. PBN capability helps to reduce route spacing and aircraft separation. Therefore both capacity and flight efficiency will be improved by enabling trajectories which are closer to user preferred routes.

**BUSINESS VIEW**

A clear and robust Business View of the SESAR programme, including the deployment costs and potential benefits of the solutions, is of paramount importance for the ANSPs budget planning.

Thus, the Business View would become the key reference for the ANSP investment decision, hence concrete business cases supporting the different operational changes are needed and will constitute, together with the Roadmaps, the backbone of the Master Plan.

Due to the absence of performance contribution validated data, benefits have been estimated assuming that performance targets are achieved.

ANSP costs for the Deployment Baseline and Step 1 (assessed within the SESAR and assessed independently by SESAR ANSPs) appear to vary widely depending on the assessment made: 2 140-4 200 M€ for the Basic Package and 3 562-6 500 M€ for the Target Package. This significant variation appears due to two different methodologies applied to estimate the costs. A bottom-up approach was followed reassessing the Definition Phase data, resulting in the lower values, whereas a top-down approach, extrapolating the actual ANSPs short term investment plans (4-5 years) to cover all Step 1, resulted in the higher values corresponding to the minimum expected cost for ANSPs.

These reasons lead to a need to update the ANSP costs, which is planned to be done by mid 2013 by a specific working group within the SJU. And that is why these figures, that are absolutely necessary to support investment planning, should be taken with caution, as the methodologies applied to obtain the costs are not homogeneous, even for the different Stakeholders. Therefore inputs from the manufacturing ground industry will be important for the aforementioned update.

**RISKS**

A number of risks to the outcomes of the ATM Master plan have been identified. From the ANSP point of view, the most critical concerns are:

- **Limits of the performance considerations (Additional risk)**
- The expectation of the performance contribution of operational changes is currently based on basic expert judgement. It is associated with validation targets for which a risk of non achievement has been identified.
- Furthermore, although validation targets are set for all the four KPAs, the current Deployment Scenarios are driven only by one KPA: capacity. This is because only Capacity Needs have been calculated based upon the traffic forecasts. Hence, the Operational Environments are classified according to the Capacity Needs, and the current economic situation is showing the need of adding more KPAs to build the Deployment Scenarios, like for example the cost-effectiveness.
- **Delays in the implementation of the Deployment Baseline (MP risk 6)**
  The Deployment Baseline provides the initial baseline for future deployment of first SESAR R&D results, but the lack of clear and complete link between deployment baseline improvements and the delay / de-synchronisation of deployment plans related to first SESAR results could jeopardise its deployment.
  Furthermore, the number of deployment priorities should be manageable, having a reduced selection of operational changes amongst the full list of the Deployment Baseline.
- **Investment to support deployment beyond Deployment Baseline is not secured (MP risk 5)**

- **Regulatory and standardisation needs are unable to support the deployment plan (MP risk 8)**
  The synchronised application of standards and common principles, together with synchronised deployment of common technical and operational solutions for aircraft and ATM Systems, will enable the planned improvement of the ATM performance to be achieved.
- **Governance structure is not capable of ensuring successful deployment (MP risk 7)**
  The future deployment governance structure may not be capable of ensuring the successful deployment of the SESAR Programme.

WWW.ATMMASTERPLAN.EU



EUROPEAN UNION

SESAR

EUROCONTROL