SESAR

THE ROADMAP FOR DELIVERING HIGH PERFORMING AVIATION FOR EUROPE

European ATM Master Plan

Executive Summary for the Network Manager   Edition 2015

EUROPEAN UNION   EUROCONTROL

Executive Summary

The Stakeholder Executive Summary for the Network Manager (NM) has been developed by the NM experts of the group that has produced the European ATM Master Plan Edition 2015. It is an executive summary with the specific Network Manager perspective on the Master Plan. In the first part it contains the Executive Summary of the main European ATM Master Plan document.

Executive Summary

What is the European ATM Master Plan?

Within the framework of the Single European Sky (SES), the European Air Traffic Management Master Plan (hereafter referred to as 'the Master Plan') is the main planning tool for defining ATM modernisation priorities and ensuring that the SESAR (Single European Sky ATM Research) Target Concept becomes a reality. The Master Plan is an evolving roadmap and the result of strong collaboration between all ATM stakeholders. As the technological pillar of the SES initiative, SESAR contributes to achieving the SES High-Level Goals and supports the SES regulatory framework.

The Master Plan details not only a high-level view of what is needed to be done in order to deliver a high-performing ATM system, but also explains why and by when. It therefore sets the framework for the development activities performed by the SESAR Joint Undertaking (SJU) in the perspective also of the deployment activities to be performed by all operational stakeholders under the coordination of the SESAR Deployment Manager and in accordance with the Deployment Programme to ensure overall consistency and alignment.

Why act now?

ATM is a critical element in the European air transport value chain and key to connecting regions and making Europe a global hub for mobility and prosperity. To ensure the sustainability and competitiveness of aviation, Europe needs to have a clear vision on how to deliver a high-performing ATM system.

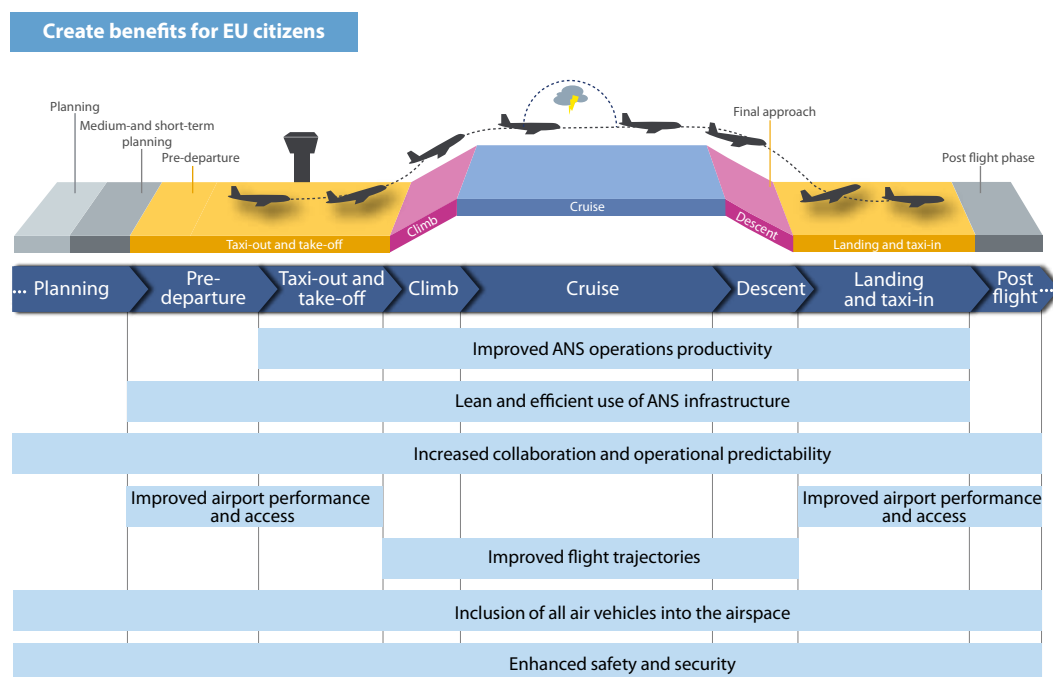Since the 2012 edition of the Master Plan, several significant developments have taken place, such as the availability of the first SESAR Solutions, the start of deployment activities and the significant change to the long term traffic forecast. ATM modernisation therefore needs to reflect a greater focus on increased efficiency and effectiveness while sustaining or even improving the levels of safety and security. At the same time, it must also recognise the need to provide solutions to address critical capacity bottlenecks.

What's new in the 2015 edition of the Master Plan?

Mindful of these developments, this edition of the Master Plan:

- introduces a vision for the future European ATM system;
- presents the first wave of SESAR deployment, such as the Pilot Common Project (PCP) [1], and details the Key Features of R & D activities (SESAR 2020);
- provides new deployment scenarios for elements that are sufficiently mature to be brought into the deployment pipeline;
- makes explicit reference to remotely-piloted aircraft systems (RPAS) and rotorcraft as airspace users, as well as to cybersecurity elements within ATM;
- incorporates the results of a more comprehensive military involvement;
- reflects synergies and consistencies with the Deployment Programme and the Network Strategy Plan.

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[1] Commission Implementing Regulation EU No 409/2013 specified the requirements for common projects. Common projects aim to deploy in a timely, coordinated and synchronised way ATM functionalities that are mature for implementation and that contribute to the Essential Operational Changes identified in the European ATM Master Plan (2012 edition). The first of these common projects is the Pilot Common Project (PCP).

Create benefits for EU citizens

Planning
Medium-and short-term planning
Pre-departure
Taxi-out and take-off
Climb
Cruise
Descent
Final approach
Landing and taxi-in
Post flight phase

... Planning	Pre-departure	Taxi-out and take-off	Climb	Cruise	Descent	Landing and taxi-in	Post flight ...
		Improved ANS operations productivity					
	Lean and efficient use of ANS infrastructure						
Increased collaboration and operational predictability							
	Improved airport performance and access					Improved airport performance and access	
			Improved flight trajectories				
Inclusion of all air vehicles into the airspace							
Enhanced safety and security							

What is the vision of the 2015 Master Plan?

Building on the 2012 edition of the Master Plan, this edition outlines the vision to achieve 'high-performing aviation for Europe' by 2035. The vision reflects the goals captured in the SES II initiative, which calls for 'more sustainable and better performing aviation' [2] and Flightpath 2050 — Europe's Vision for Aviation [3], which states that in 2050, 'The European aviation community leads the world in sustainable aviation products and services, meeting the needs of EU citizens and society'.

The vision builds on the notion of 'trajectory-based operations' and relies on the provision of air navigation services (ANS) in support of the execution of the business or mission trajectory — meaning that aircraft can fly their preferred trajectories without being constrained by airspace configurations. This vision is enabled by a progressive increase of the level of automation support, the implementation of virtualisation technologies as well as the use of standardised and interoperable systems. The system infrastructure will gradually evolve

with digitalisation technology, allowing air navigation service providers (ANSPs), irrespective of national borders, to plug in their operations where needed, supported by a range of information services. Airports will be fully integrated into the ATM network level, which will facilitate and optimise airspace user operations. Going beyond 2035 towards 2050, performance-based operations will be implemented across Europe, with multiple options envisaged, such as seamless coordination between ANSPs or full end-to-end ANS provided at network level.

Furthermore, it is widely recognised that to increase performance, ATM modernisation should look at the flight as a whole, within a flow and network context, rather than segmented portions of its trajectory, as is the case today. With this in mind, the vision will be realised across the entire ATM system, offering improvements at every stage of the flight.

Reaching the performance ambition will also require a change in the way that solutions are deployed, as well as possible evolutions in the way services are provided. Through a four-phase approach, this change would see the high-level architecture gradually moving from locally specific architecture to a more interoperable, common and flexible service provision infrastructure at regional or network level (see Chapter 2).

[2] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions on SES II, COM(2008) 389/2, 25 June 2008.

[3] Report of the High-Level Group on Aviation Research, 2011, EUR 098 EN.

SESAR's performance ambition

SECURITY
• Ensuring high levels of security

COST EFFICIENCY
• Up to **40%** reduction in air navigation services costs per flight

CAPACITY
• Up to **30%** reduction in departure delays
• Up to **10%** additional flights landing at congested airports
• A system capable of handling up to **100%** more traffic

ENVIRONMENT CO₂
• Up to **10%** reduction in CO_2 emissions
• Positive impact on noise and air quality

SAFETY
• Improvement by up to a factor of **4**

OPERATIONAL EFFICIENCY
• Up to **6%** reduction in flight time
• Up to **10%** reduction in fuel burn

What is the ATM performance ambition for Europe?

The performance ambition supported by SESAR is aspirational and refers to the performance capability that may be achieved if SESAR Solutions are made available through R & D activities, deployed in a timely and, when needed, synchronised way and used to their full potential. While acknowledging that the performance gains at local level will also depend on local conditions, it shows that significant performance gains can be achieved in Europe in a number of key areas, namely the environment, capacity, cost efficiency, operational efficiency, in addition to safety and security. The ambitions described are compared to the situation in 2012 and rely on the optimal development and deployment of a series of operational changes through SESAR Solutions (see Chapter 3).

What is needed to achieve this performance ambition?

The technical evolution of the future system is now closely connected to these performance ambition levels. In order to deliver, SESAR will enable a step change in system capabilities
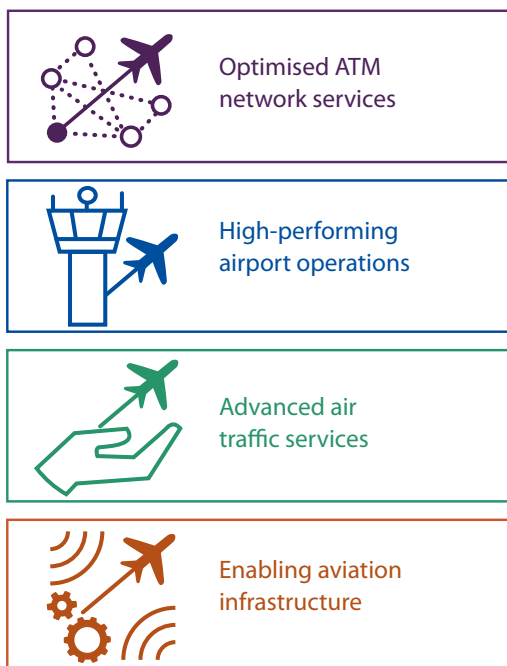
What is needed to achieve the performance ambition?

Automation support — Automation and use of data communications	**Integrated systems** — Lean and modular systems, easily upgradable and interoperable
Integration of all vehicles — All air vehicles fully integrated in ATM environment (incl. RPAS)	**Sharing of information** — Information shared digitally via data services
Flight- and flow-centric operations — Airspace users fly their preferred business and mission trajectory in a flow and network context	**Virtualisation** — Virtualisation allowing more dynamic resource allocation

by 2035 with higher levels of automation, digitalisation and virtualisation.

The Master Plan identifies the related changes and groups them according to whether they are already in place, in the pipeline towards deployment, or planned as part of future R & D activities (see Chapter 4).

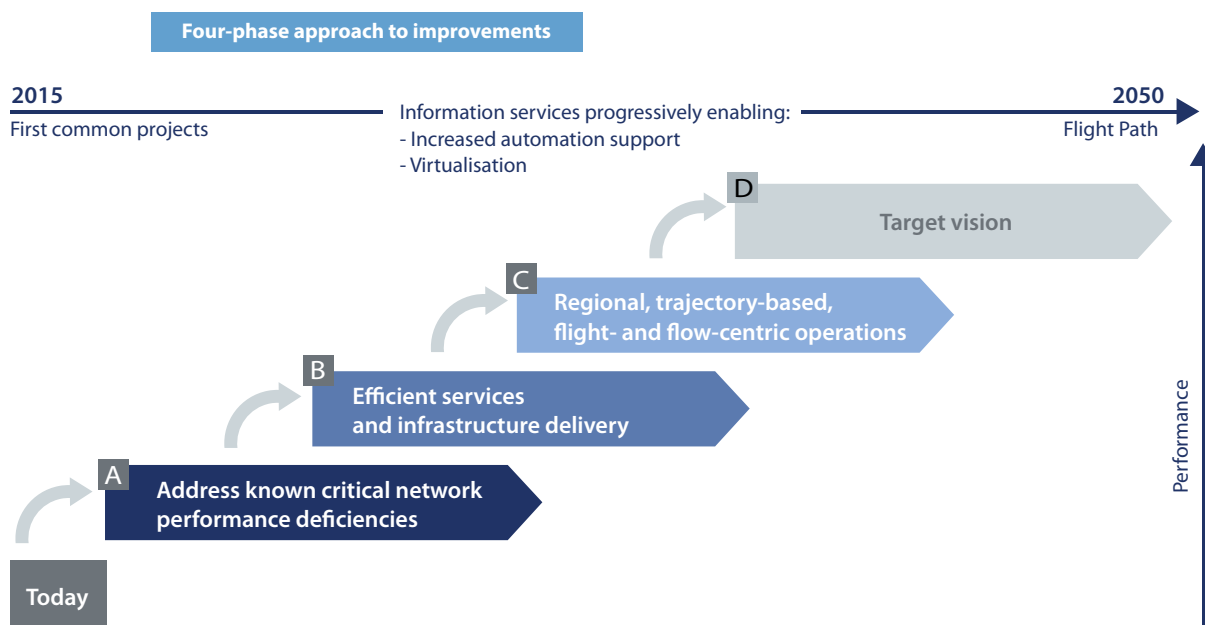These changes are categorised according to four areas of ATM (Key Features):

Optimised ATM network services

High-performing airport operations

Advanced air traffic services

Enabling aviation infrastructure

Further operational changes relating to RPAS and cybersecurity are also featured in the Master Plan. Key to success is the ATM workforce, which the Plan underlines as an integral part of the overall ATM system, and as the most critical source of its performance, safety and resilience. As in past and present operations, ATM performance will remain the result of a well-designed interaction between human, procedural, technological, environmental and organisational aspects.

What is the timeline for deployment?

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

The Master Plan includes roadmaps of the identified changes, ensuring that their deployment is planned in a performance-driven and synchronised way (e.g. between ground and air deployments) to maximise the benefits gained. The Master Plan also gives targeted dates for deployment; however, these are subject to further considerations after validation and proper identification of supporting business cases.

Four-phase approach to improvements

2015
First common projects

Information services progressively enabling:
- Increased automation support
- Virtualisation

2050
Flight Path

D

Target vision

C

Regional, trajectory-based, flight- and flow-centric operations

B

Efficient services and infrastructure delivery

A

Address known critical network performance deficiencies

Today

Performance

Direct and quantifiable benefits for European ATM and aviation	Benefits for EU economy and society
- **ANS productivity:** reduced en-route and TMA costs per flight - **Operational efficiency for airspace users:** reduced fuel burn and flight time - **Capacity:** reduced delays, increased network throughput and throughput at congested airports - **Environment:** reduced CO_2 emissions - **Safety and security:** high standards	- Industrial leadership in ATM and aviation at the forefront of innovation - A more competitive EU aviation industry in the global aviation landscape - Increased mobility with a lower environmental impact - Significant contribution to EU GDP and job creation - High standards in terms of safety, security and social standards

What are the expected costs and benefits?

The realisation of the vision will not only bring significant direct and quantifiable performance gains to ATM and aviation, but it will also mean benefits for the EU economy and society in general, as described.

In terms of cost savings, the Master Plan estimates important improvements in several areas, depending on how SESAR is deployed. Two options are put forward: on the one hand an optimised deployment scenario with greater integration of the ATM infrastructure, and on the other hand a local deployment scenario.

It is estimated that cost savings and the value of all performance benefits would amount to annual recurring benefits ranging potentially from EUR 8 billion to EUR 15 billion per year in 2035, compared to a scenario where SESAR would not be deployed. These savings imply higher levels of coordination on how and where to invest, as well as the early application of standardisation and harmonisation of procedures. More critically, these savings also rely on the deployment of infrastructure with a long-term horizon which is optimised at network level, amounting to a total investment in the range of EUR 18 billion to EUR 26 billion in the period up until 2035 (see Chapter 6).

Why is the Master Plan important for global interoperability?

Aviation is a global industry and interoperability together with global harmonisation are key for its safe and sustained growth. The EU-US Memorandum of Cooperation (MoC) provides the framework for SESAR and FAA's NextGen coordinated approach in particular with regards to the International Civil Aviation Organisation's (ICAO) harmonisation efforts. This latest update of the Master Plan is timely as it will serve to contribute to the update of the ICAO's Global Air Navigation Plan (GANP) and the Aviation System Block Upgrades (ASBUs) in 2016.

The Master Plan: a shared and maintained strategy for the evolution of European ATM

The Master Plan is a regularly updated plan (every 2-3 years) which involves all stakeholders. It represents the strategy for the performance-driven evolution of the European ATM system for institutional as well as industrial players.

The Master Plan's successful implementation is a key enabler for high-performing aviation in Europe, providing increased connectivity, supporting sustainable economic growth and promoting European industrial leadership at a global level.

Stakeholder Executive Summary for the Network Manager

Executive Summary
for the Network Manager

Network Manager Perspective

This edition of the ATM Master Plan primarily builds on the Essential Operational Changes which will be deployed though the Pilot Common Project and develops new Essential Operational Changes which constitute the content of the future Deployment Scenarios. It also identifies research and innovation areas to be addressed in the SESAR 2020 time frame.

The Network Manager (NM) relevant operational changes and technology elements are based on these ATM Master Plan Essential Operational Changes.

The Network Strategy Plan (NSP) is consistent with the ATM Master Plan and full traceability has been established between the NSP Strategic Objectives and the ATM MP Essential Operational Changes.

Complementarity is also ensured in areas where NSP is addressing issues beyond the technology driven changes of the ATM Master Plan aiming to maximise network performance. The performance impact and the detailed planning of operations are found in the Network Operations Plan (NOP).

The execution of the Network Strategy Plan is accomplished by a number of established Network Strategic Projects. The ATM Master Plan and SESAR 2020 work programme through its focused research and its deployment view become the tool which addresses the relevant needs of NM Strategic Projects and Services.

Network Manager Needs

The Network Manager's main aim is to further connect the Network to deliver improved performance. It needs to address current network weaknesses such as wasted/unused capacity, the gap between flight efficiency targets and preferred airspace user trajectories and the fragmented infrastructure deployment.

The Network Manager considers SESAR as one of the main means to support delivering its performance contributions in the areas of safety, capacity, environment, predictability and cost efficiency.

The ATM Master Plan also provides the instrument for an efficient synchronisation of investments for the NM systems evolution with those of ANSPs, Airspace Users (civ/mil) and airports.

The Network Manager operational concept and vision is developed in the context of its collaborative decision-making process involving the respective operational stakeholders and making best use of the relevant technology changes.

The Network Operational Concept is addressing the Network Strategy Plan operations direction and for the medium-term future concentrates on the following key areas:

a) Seamless and Flexible Airspace management,

b) Optimum capacity and flight efficiencyplanning,

c) Business Trajectories and Cooperative Management,

d) Airport capacity optimisations and Airport-Network integration and

e) Optimisation of Network Infrastructure and Information Sharing.

The Concept is evolving taking advantage of the maturing SESAR technology elements and focuses to the successive SES Performance Reference Periods.

These key areas of the network operational concept are shown in the following graphical illustration.
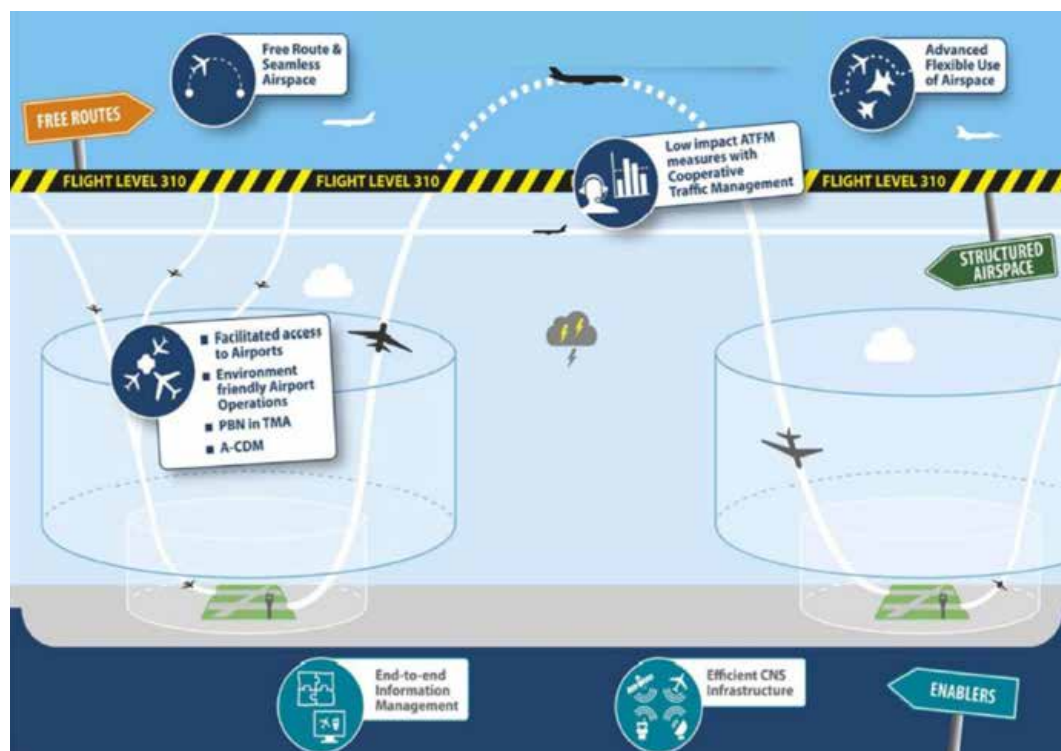
Deployment View

Existing initiatives (Deployment Baseline)

In order to contribute to the challenging performance targets the Network Manager orchestrates a number of short-term implementation actions in cooperation with operational stakeholders. The key existing initiatives include amongst others:

- Initial Free Route implementations: By 2014, more than 25 ACCs in Europe conducted FRA operations allowing Airspace Users (AUs) to save 25000 nautical miles per day representing a saving of EUR 37 million per year. The Network Manager systems have been properly upgraded to fully support these operations.

- Airspace management and FUA: Enhanced airspace design solutions (some 250 airspace improvements) have been implemented in a harmonious way throughout Europe. Shorter and alternative routes are offered. All together, they contribute to the flight efficiency and cost-efficiency targets.

- Initial NOP: Cost effective and user friendly, web-based services have been introduced enhancing the collaboration between the concerned partners and addressing normal operations as well as crisis management.

- STAM: Short-term ATFCM Measures are implemented using the existing system support and a procedure-based approach.

- Airport Collaborative Decision Making (A-CDM): More than 24% of the departures in Europe are benefiting from A-CDM implementation. The "advanced tower concept" (tower with Departure Information (DPI) messaging) is promoted by the NM aiming to have it implemented at 50 airports by 2019.

- Continuous Climb/Descent Operations (CCO/CDO): Particular attention has been given to support continuous operations in as many airports as possible (almost 89 airports have published Continuous Descent Operations in the relevant AIPs).

- Initial rationalisation of CNS: Rationalisation and modernisation of CNS infrastructure is partially addressed by NM through several projects including 8.33KHz VCS implementation, VoIP (voice over IP) implementation, sustainability of 1030/1090MHz radio frequency bands in high traffic-density areas, enhancement of surveillance coverage and data use and analysis of CNS security.

Pilot Common Project (PCP)

The "Pilot Common Project" (EC Implementing Regulation IR 716/2014) provides enhanced opportunities for a synchronised and accelerated implementation of Essential Operational Changes required to modernise and enhance the performance of ATM in Europe. NM is aligning its implementation activities with the SESAR Deployment Programme as required. In this context NM is developing a number of multi-stakeholder implementation projects (IPs) with Airspace Users (including Computerised Flight Planning Service Providers (CFSPs)), Airports and Air Navigation Service Providers as appropriate. Several Essential Operation Changes are very closely associated with the Network Manager Functions and expect to contribute significantly to the performance of the Network. They include.

Seamless and Flexible Airspace management

- Airspace Management (ASM) and Advanced Flexible Use of Airspace (A-FUA)

- Free route will continue to be deployed through the use of direct routing airspace (DRA) and through free routing airspace (FRA) extending its application to the whole ICAO EUR region above flight level 310.

Optimum capacity and flight efficiency planning

- Collaborative NOP

- Automated support for traffic complexity assessment

- Calculated Take-off Time to Target Times (CTOT to TTA) for ATFCM purposes

- Enhanced Short-Term ATFCM Measures

Master Plan Deployment View (New Essential Operational Changes)

To complement the PCP Deployment Programme issued by the SESAR DM, the Master Plan also describes deployment scenarios beyond the PCP and identifies relevant Essential Operational Changes. Several Essential Operational Changes are very closely associated with the Network Manager functions expecting to contribute to the performance of the Network. They include in particular:

Optimum capacity and flight efficiency planning

- User-driven prioritisation process (UDPP) gives airspace users the opportunity to exchange the departure order of any two flights from different airlines penetrating the same constraint (airspace volume, arrival airport). This allows airspace users, within commercial agreements, to reduce the delay of a commercially sensitive flight at the cost of another flight. UDPP facilitates ATFCM planning and departure sequencing through advanced airport operations (CDM, advanced dynamic capacity balancing).

Business Trajectories and Cooperative Management

- Information sharing and business trajectory refers to the initial Reference Business Trajectory (iRBT), which will include all initial Shared Business Trajectory (iSBT) information and will contain, among other information, target times over/arrival (TTO/TTA).

- Mission trajectory is the reference used by all ATM partners during flight execution for flights using ARES airspace. The same flight information as business trajectories is shared. The initial Shared Mission Trajectory (iSMT) will be part of the CDM process, published using NOP with all required data including the allocation of target times. The iSMT will be exchanged with ATC using an improved flight plan. The initial Reference Mission Trajectory (iRMT) will be the partial implementation of the mission trajectory.

Business Trajectories and Cooperative Management

- Flight information exchange

- Initial Trajectory Information Sharing (i4D)

Airport capacity optimisations and Airport-Network integration

- Airport Operations Plan

- Arrival management extended to en-route airspace (E-AMAN)

Optimisation of Network Infrastructure and Information Sharing

- SWIM technical infrastructure and profiles

- Aeronautical information exchange

- Meteorological information exchange

- Cooperative network information exchange

The Network Manager and the SESAR Deployment Manager signed an agreement to cooperate for the efficient and timely implementation of the PCP.

Research and Development View

Airport capacity optimisations and Airport-Network integration

- Collaborative airport interfaces the landside with the ATM Network. In this framework, airport operations planning, monitoring, management and post operations analysis tools and processes are built into the AOP and A-CDM for normal, adverse and/or exceptional operating conditions. TTA are derived from the AOP, and are used by NM to balance arrival demand and capacity that will facilitate arrival management processes from the en-route phase. These processes are fully compatible with the NOP and based on SWIM services.

Optimisation of Network Infrastructure and Information Sharing

- CNS rationalisation will lead to network optimisation, following the implementation of new functionalities and/or technologies that support higher performance and efficiency (in terms of cost, spectrum, etc.). Impact assessments will be made as soon as the new technologies are mature so that old technologies and systems can be replaced/ restructured.

- Digital integrated briefing refers to system improvements made to pilot briefing information on the ground (including at the gate). Accessible on board the aircraft, the digitally enhanced briefing integrates the aeronautical information service (AIS), METEO and other relevant information (e.g. ATFCM, FUA), and is presented in an interactive manner.

The Master Plan defines research and development activities to be addressed by SESAR 2020. It identifies both key research and development and innovation activities as well as some additional activities. Among the key R&D activities several are of particular interest for NM as they have potential to contribute to the performance of the network. They include amongst others:

Seamless and Flexible Airspace management,

- Management of dynamic airspace configurations

- Trajectory based free routing in low levels and high complexity sectors

- Dynamic and enhanced PBN routes and airspace

Optimum capacity and flight efficiency planning,

- Advanced DCB

- Collaborative network management

- Optimised AU Operations with fleet prioritisation and preferences (UDPP), Flight- and flow-centric ATC

- 4D trajectory management and trajectory sharing

Business Trajectories and Cooperative Management

- Airspace User Processes for trajectory definition and Airspace User trajectory execution from the Flight Operations Centre (FOC)

- Mission Trajectories

- Integration of trajectory management processes in planning and execution

- Flight information exchange mechanisms

Airport capacity optimisations and Airport-Network integration

■ Use of Arrival and Departure Management information for traffic optimisation within the TMA and improved consistency with the network view.

■ Enhanced collaborative airport performance management

Optimisation of Network Infrastructure and Information Sharing

■ CNS environment evolution, CNS avionics integration, CNS ground segment integration

Business View

The SESAR solutions and the Essential Operational Changes provide the main foundation for achieving the performance ambitions and contributing to the SES goals.

The collaborative Network Operations Planning links all participating organisations to a commonset of network planning data enabling individual players to play an active role in the network management based on the subsidiarity principle "think regional, act local". In nominal situations, macro-optimum solution should be chosen in favour of the micro-optimum. However, there are micro- optimisations that the macro world does not need to know about because the impact remains local or between two coordinating actors only. An agreed set of rules will guide the Network Management functions at all levels to escalate only those issues which need to be escalated.

The Master Plan Business View is a high-level view. A more elaborated analysis with dedicated business cases and cost benefit considerations needs to be undertaken to support relevant investment decisions.

The Business View identifies two high-level options for the implementation of the Master Plan vision: the optimised ATM infrastructure deployment option and the local deployment option. It highlights that the ATM infrastructure deployment option would provide 7 billion higher overall benefits in net present value as compared to the local deployment option and recommends the implementation of this cost-beneficial option.

The Network Manager is prepared to play a key role for the implementation of the optimised ATM infrastructure deployment option.

Risks

A number of risks related to the implementation of the Master Plan have been identified (Chapter 7). From the NM perspective, the most critical risks are:

- Clarity of vision and architecture considerations: A number of architectural principles supported by tools and technologies have been identified in the Master Plan aiming at increasing interoperability and reducing the highly fragmented nature of ATM in Europe. The development and introduction of "common support services" including opportunities for "non local" deployment should not be neglected since they could provide an essential element of the expected evolution of the ATM business model (Master Plan risks 6 & 7).

- Limitations of performance considerations and their realistic association with pre-determined time horizons: The assessments of performance contributions are based on experts' judgment. The performance ambitions are very challenging and the expected SESAR contribution to those has to be well defined. The SESAR 2020 programme with its specific Very Large Scale Demonstration (VLD) exercises is expected to bring better assessments to those performance contributions. A clearer link between performance needs and SESAR contributions for pre-determined time horizons needs to be elaborated (MP risk 6).

- Confidence in the maturity of enablers and proper hand over for deployment: The maturity of enablers and their handover to implementation need to be more carefully considered. Deployment steps need to be supported by well elaborated, detailed enough and implementation focused concepts of operations agreed by all impacted stakeholders (MP risk 3).

- Availability of appropriate resources and material (incentives, standards) for deployment: The provision of adequate resources and material including the availability of standards and common principles, together with the synchronised deployment of common technical and operational solutions for the air and the ground part of the ATM Systems, will enable the planned improvement of the ATM performance to be achieved (MP risks 3 & 4).

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