AIR TRAFFIC MANAGEMENT SYSTEM FOR 2020 AND BEYOND

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1. OVERVIEW

SESAR is a programme to modernise the European Air Traffic Management (ATM) System. It is currently in its feasibility definition study phase and is addressing collectively the technological, economic and regulatory aspects associated with ATM. The SESAR Consortium, has brought together, for the first time in ATM history, the major stakeholders in European aviation to develop a common vision of the future ATM System. The study will produce an agreed Master Plan of the research, development and implementation plans and actions needed to be taken by the different stakeholders to realise the System. This paper will summarise the progress made by describing results covering the:

- assessment of the future air transport market place into which future ATM services will be delivered;
- management and performance frameworks which will govern the future operation of the System, its further evolution and other related activities;
- performance requirements which the future System must meet;
- 4) nature of the Future ATM Target Concept, this comprising the:
 - a. concept of operations to be adopted;
 - b. structure of the overall architecture needed for the system;
 - c. set of technologies to be developed and used to implement it.

1.1. Keywords

Air Traffic Management, Single European Sky legislation, European ATM Master Plan, ATM Target Concept, Concept of Operations, Performance Target, SESAR.

2. BACKGROUND

SESAR is a programme to modernise the European Air Traffic Management (ATM) System. It is currently in its feasibility / definition phase study which is being cofunded by the European Commission and EUROCONTROL. It is addressing collectively the technological. economic and regulatory aspects associated with the modernization of the European ATM System. Following the successful completion of

the definition phase study, it will use the Single European Sky (SES) legislation to synchronise the plans and actions of the different stakeholders in ATM and federate the resources needed for the development and implementation of the required improvements throughout Europe; this applying to both the applicable airborne and ground systems domains.

The study is being conducted over a 2-year period (which started in March 2006) by the SESAR Consortium, a grouping that, for the first time in ATM history, has brought together the major stakeholders in European aviation to develop a common vision of the future ATM System. The SESAR Consortium draws upon the expertise of the major organisations within the aviation industry. This includes airspace users, air navigation service providers (ANSPs), 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 which work together with significant expertise being provided by EUROCONTROL.

The study will produce an agreed Master Plan of the research, development and implementation plans and actions needed to be launched by the different stakeholders to realise the future European ATM System. This Plan is developed through the production of 6 main deliverables over the 2 years and covers all aspects of the future ATM System, including its supporting institutional framework. The scope of the 6 deliverables (D1 to D6) is as follows:

- 1) D1: Air Transport Framework the Current Situation
- 2) D2: Air Transport Framework the Performance Target
- 3) D3: Definition of the future ATM Target Concept
- 4) D4: Selection of the "Best" Deployment Scenario
- 5) D5: Production of the ATM Master Plan
- 6) D6: Work Programme for 2008–2013.

This paper will summarise the progress made to date by describing the results achieved within the deliverables D1 and D2. In outline terms, these cover:

- 1) a summary snapshot of the current situation to identify the main areas of improvement;
- an assessment of the future air transport market place into which future ATM services will be delivered;
- the management and performance frameworks which will govern the future operation of the System and its further evolution;
- 4) an initial set of performance requirements which the future System must meet.

3. AIR TRANSPORT FRAMEWORK – THE CURRENT SITUATION

Air transport is an essential element of the European and Global economies, and to meet the future needs of its users and respond to the demands being placed upon it by society, it must be further developed in a responsible and sustainable manner. Likewise, the future European ATM System must be able to cope with the anticipated growth in air traffic. It must be implemented with a servicecentric approach by tackling the fragmentation which exists throughout today's System and the associated institutional arrangements. There is a need for one simplified European framework and all stakeholders have a role to play in progressively modernising the System to cope safely with the increased demand for such services. Business as usual is not an option.

The assessment of the current situation and it's conclusions and recommendations are summarised from 4 perspectives, those of air transport, ATM, the governing institutional framework and the "System" aspects.

3.1. Principal Conclusions and Recommendations for Air Transport

- Aviation offers its customers a safe, excellent value for money means of transport;
- On a peak day in Europe ATM controls ~30,000 commercial flights operated by ~5,000 aircraft. Services are also provided to ~200,000 general aviation (GA) operated by ~50,000 aircraft, plus numerous military aircraft.
- 3) The number of flights is expected to at least double by the year 2020.
- 4) In the industry's value chain as it stands at present, commercial airspace users are, in general, the most exposed link, being the first to suffer financially when demand falls.

In order to respond successfully to these challenges, it has been concluded that all stakeholders in the air transport industry must jointly grow their businesses in a way which strengthens the value chain relationships between them.

3.2. Principal Conclusions and Recommendations for ATM

Over the past decade ANSPs have coped with significant traffic growth in an acceptably safe & expeditious manner such that, today, delays are at the historically low level of 1.9mins./flight. In terms of expanding overall capacity in the future, currently it is airports which are the limiting factor. However, it has been concluded that the principal disadvantages of the current System are as follows :

- Fragmentation of the way in which air navigation services are provided throughout the current European ATM network & its associated effect on productivity costs the industry ~€2Bn per year.
- National infrastructures have low-levels of interoperability & there is a lack of cooperative planning in the investment, planning and management of their assets.
- Today's ATM process is not sufficiently geared, or flexible, to maintaining the schedules of the commercial airspace users.

Consequently, to address the major shortcomings of the current situation, it has been recommended that the design & management of the future European ATM System should be based upon developing :

- a common framework which links the economic, commercial & operational values of its stakeholders and the establishment of explicit service relationships between them;
- 2) a comprehensive performance framework to be applied across the System as a whole;
- the concept of a "network plan" to deliver the services and benefits needed by all users of "the network";
- an approach which applies the principles of asset management to link the strategic planning of new investments with the in-service support of the operational systems.

3.3. Principal Conclusions & Recommendations concerning the Institutional Framework

The International Civil Aviation Organisation (ICAO) framework is considered to still be adequate for harmonising aviation globally, but the time taken to develop its products is too long to meet the rapidly changing needs of the business today.

The SES regulatory framework complements the ICAO framework and, whilst ensuring safety remains the prime objective, paves the way for a more commercial approach to be taken to providing air navigation services. However, the following overall conclusions were drawn.

- The institutional framework is complex & fragmented, with too many diverse organisations having a lack of clear roles and responsibilities across the activities of regulation, standardisation & decision-making.
- 2) The institutional aspects are continually changing, making it difficult to remain compliant in a cost effective way.

These led to making the following recommendations for the subsequent stages of the study:

- A simpler, coherent framework of legislation & regulation is needed, matched to ATM's future business model.
- 2) The future institutional & business frameworks must be designed to have a "dynamic working relationship" between them, but that these must be working to the same performance-based framework.
- The approach to standardisation in the future must concentrate on service & functional performancebased regulation.

3.4. Principal Conclusions and Recommendations concerning the "Systems" Aspects

When considering some of the more technical aspects related to how ATM is performed today, the main conclusions were as follows.

- 1) There is currently no common architectural design of a European ATM System.
- 2) Research & Development (R&D) activities have, in general, been conducted in a fragmented manner and not focused upon addressing clear business needs; nor have they done sufficient business planning and safety case work to bring their products into operational service in a timely manner and cost effective manner.
- 3) Humans are at the centre of all activities, but expectations are that they will not be able to deal with the future level of traffic and its complexity in the same way as is done today.
- 4) There is a need for a paradigm shift in today's concept of operations to break through the "capacity barrier" predicted to occur around 2015.

To go some way to addressing these, the following key recommendations were made and to be taken forward.

- 1) A single functional architecture, including defining the information flows throughout it, must form the basis of the future European ATM System.
- 2) The future ATM System will treat the design of the airborne and ground systems as one.
- A single European ATM System "design authority" role should be established to define, plan & manage the future System, coupling R&D activities, strategic planning, implementation programmes & asset management activities.
- A comprehensive approach to change management, which engages staff at all levels in a collaborative, inclusive and transparent manner, needs to be established.

4. AIR TRANSPORT FRAMEWORK – THE PERFORMANCE TARGET

The European Air Traffic Management System is operating close to its limit:

- The current Air Traffic Management (ATM) System was designed decades ago and is based on an operational concept and technologies, which are reaching their limits.
- 2) The existing airport infrastructure cannot fully

accommodate the increasing demand. While this could be partially mitigated by e.g. the use of secondary airports and an intermodal transport system, additional airport infrastructure will still be required.

SESAR - Key for Success

In response to the ATM challenge, the European Commission (EC) launched the SESAR programme, with the objectives, as expressed by Vice-President Jacques Barrot, to achieve a future European ATM System for 2020 and beyond, which can, relative to today's performance:

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

ATM - SESAR Vision

The proposed SESAR Vision is to achieve a performance based European ATM System, built in partnership, to best support the ever increasing societal and States', including military, expectations for air transport with respect to the growing mobility of both citizens and goods and all other aviation activities, in a safe, secure, environmentally sustainable and cost-effective manner.

Central to achieving this Vision, is the concept of placing the best overall outcome of individual flights at the heart of the ATM network. The SESAR Vision is dependent upon three distinct ATM frameworks, to which all stakeholders have to commit and operate:

- 1) The "Performance Framework"
- 2) The "Business Management Framework"
- 3) The "Institutional and Regulatory Framework".

4.1. The Performance Framework

An ATM performance based approach is considered essential to drive management decisions towards achieving the Vision.

The present air traffic service performance assessment mainly addresses the performance of ANSPs. As this structure has proven its value, it can form the basis for the evolutionary development of a Performance Framework extended to include all ATM stakeholders.

The SESAR Consortium has started to address the definition of the 2020 performance by setting initial targets. These will be continuously refined within the lifetime of the ATM Master Plan.

The ATM Performance Targets for 2020

ATM performance covers a very broad spectrum of aspects, which are represented through eleven Key Performance Areas (KPAs). The diagram below is illustrative of the KPAs and how they could develop towards the 2020 targets.



Four KPAs, directly linked to EC objectives and the achievement of the proposed SESAR Vision are described below. The other seven KPAs (Efficiency, Flexibility, Predictability, Security, Access and Equity, Participation, Interoperability) are further addressed in the D2 Milestone Deliverable of the SESAR Consortium.

The KPA targets represent initial indicative values (working assumptions), subject to further analysis and validation. All KPAs are interdependent and will be the basis for impact assessment and consequent trade-off analysis for decision-making in the subsequent SESAR Milestone Deliverables.

Capacity - Traffic will grow.

In accordance with the political vision and goal, the ATM target concept should <u>enable</u> a 3-fold increase in capacity which will also reduce delays, both on the ground and in the air (en-route and airport network), so as to be able to handle traffic growth well beyond 2020.

The deployment of the ATM target concept should be progressive, so that only the required capacity is deployed at any time.

The target for Capacity deployment is that the ATM System can accomodate by 2020 a 73% increase in traffic (from 2005 baseline) while meeting the targets for safety and quality of service KPAs (Efficiency, Flexibility, Predictability).

<u>Safety</u> - Proactively manage safety with the goal of no ATM related accidents.

The SESAR safety performance objective builds on the ATM2000+ Strategy objective: "To improve safety levels by ensuring that the numbers of ATM induced accidents

and serious or risk bearing incidents (includes those with direct and indirect ATM contribution) do not increase and, where possible, decrease".

Considering the anticipated increase in the European annual traffic volume, the implication of the initial safety performance objective is that the overall safety level would gradually have to improve, so as to reach an improvement factor of 3 in order to meet the safety objective in 2020 (based on the assumption that safety needs to improve with the square of traffic volume increase).

In the longer term (design life of the concept) safety levels would need to be able to increase by a factor 10 to meet a possible threefold increase in traffic.

Environment - ATM will deliver its maximum contribution to the environment.

As a first step towards the political objective to enable a 10% reduction in the effects flights have on the environment:

Achieve the implicit emission improvements through the reduction of gate-to-gate excess fuel consumption addressed in the KPA Efficiency. However no specific separate target could be defined at this stage for the ATM contribution to atmospheric emission reductions.

- Achieve the implicit emission improvements through the reduction of gate-to-gate excess fuel consumption addressed in the KPA Efficiency. However no specific separate target could be defined at this stage for the ATM contribution to atmospheric emission reductions.
- 2) Minimise noise emissions and their impacts for each flight to the greatest extent possible.
- Minimise other adverse atmospheric effects to the greatest extent possible. Suitable indicators are yet to be developed.
- 4) The aim is that all proposed environmentally related ATM constraints would be subject to a transparent assessment with an environment and socio-economic scope; and, following this assessment the best alternative solutions from a European Sustainability perspective are seen to be adopted.

Local environmental rules affecting ATM are to be 100% respected (e.g. aircraft type restrictions, night movement bans, noise routes and noise quotas, etc.). Exceptions are only allowed for safety or security reasons.

Cost-Effectiveness – Halve the total direct ATM costs.

The working assumption for the Cost Effectiveness target is to halve the total direct European gate-to-gate ATM costs from €800/flight (EUROCONTROL Performance Review Report 2005) to €400/flight in 2020 through progressive reduction. Notwithstanding this 2020 target, continuing cost improvement should be sought after 2020.

This "Performance Framework" provides a common basis to ensure the effectiveness of the ATM System and links

the other two ATM frameworks - "Business Management Framework" & "Institutional and Regulatory Framework" together which are balancing general public and industry interests in a "dynamic working relationship", that addresses how the safety, security, environmental, design and financial aspects are managed and regulated.

4.2. The ATM Business Management Framework

Its objective is to ensure that the new Operational Concept will be fully implemented in a consistently organized manner throughout all phases of the European ATM System lifecycle, including ATM strategic planning starting with the ATM Master Plan.

In order to achieve this objective the stakeholders, including airspace users, airport operators and air navigation service providers (ANSPs) will have to establish an ATM Performance Partnership. This will define roles and responsibilities based on a shared set of values, priorities, and network interactions.

In particular joint decision-making and coordinated business planning must be the basis of the ATM Master Plan. The introduction of this framework represents a paradigm shift for each stakeholder from the present fragmented decision making process to the execution of a common ATM strategic planning.

In the ATM Performance Partnership, Functional Airspace Block (FAB) initiatives are strongly supported and seen as one of the main vehicles to improve ATM performance, reducing the impact of fragmentation on the cost of air traffic service provision. These will initially develop through regional arrangements between States and ANSPs and lead to further ANSP cooperation, alliances or mergers, including the appropriate regulatory structures.

The financing and funding of the future ATM System will depend upon the options chosen for the business model of the ATM Performance Partnership, while avoiding an increase in the unit rate due to peak investment costs. Several options are to be studied to support the transition, from a fully capital market driven pre-financing scheme to a reasonable mix between charging scheme and financial market pre-financing, including possible Public Private Partnership (PPP) models.

4.3. The ATM Institutional and Regulatory Framework

Its objective is to ensure societal expectations are met and to enable the development, operation and growth of a sustainable European air transport system, through the Business Framework.

It needs to have a simple and well-structured set of regulations and regulatory actions allocated at global, European or national level, whilst continuing to rely on Member States for enforcement. It will respond to States requirements and work closely with industry to ensure rules are fair, proportionate and to safeguard a level playing field.

The SESAR Joint Undertaking (JU), as the first European ATM PPP, is seen as an important move forward and an initial step to manage the development of SESAR. It is considered as an initial structure capable of maintaining the ATM Master Plan, managing the R&D programme of technical activities, and monitoring its deployment.

The ATM Institutional and Regulatory Framework has to be flexible so it easily adapts to business and societal changes. Although outside the scope of the SESAR project, the modernisation of this framework is considered to be urgent by the industry.

4.4. The Role of the Human in ATM

Irrespective of any future vision the human will remain the most flexible and creative element to direct the performance of the overall ATM System including the management of threats, errors and unpredictable events. In order to meet the challenge of the performance objectives of the future ATM System, the Concept of Operations will evolve and will benefit from greater support from automation and an increased integration of airborne and ground capabilities.

It is identified that the changes in the operation of the future ATM System will involve a change in the human roles which requires an extensive change management process that integrates Human Factors, Social Dialogue and all relevant aspects of recruitment, training, competence verification and staffing proactively and throughout the entire process of system development, design and implementation.

The European Civil Aviation Sectorial Social Dialogue Committee is considered as a first promising step to have a European social dialogue, which could be expanded to cover more social provisions by way of collective agreements if social partners (at European level) so desire.

Continuous social dialogue between management and operational staff at a working level should be established as one important means in an advanced change and transition management process to identify and address the social impacts of introduced changes. A better awareness and understanding of the Social Dialogue practices and processes can be created. Its effectiveness and impacts on ATM performance should be further investigated during the SESAR Development and Deployment Phase.

5. THE WAY AHEAD – FROM THE PERFORMANCE TARGETS TO THE CONCEPT OF OPERATION

The Concept of Operation will be the core of the Milestone Deliverable D3 document that the SESAR Consortium will deliver in the summer of 2007. Some main elements of the future Concept of Operations are taking shape and can be summarized as follows:

Business Trajectory Management

It has been acknowledged that the primary objective of the Concept is to get the "best overall outcome" for a flight – this characteristic of the Concept is referred to as the "Business Trajectory".

The "Business Trajectory" is the representation of an airspace user's intention with respect to a given flight. It is aimed at guaranteeing the best outcome for the flight as seen from the airspace user's perspective. At the airspace user's discretion this outcome may be with respect to the minimum time for the flight, the minimum cost, or any other characteristic of the trajectory. Although perhaps not as obvious as for commercial airlines, business aviation, general aviation and the military also have their own "business" intention. The emphasis is on "intention" and naturally, all must be carried out in a manner which guarantees the safety of life and takes into account the need to meet environmental and security requirements.

It is the basis for all partners in the ATM System design, planning and operation to enable the optimal performance of the flight, resulting in optimization of the whole European network performance.

The notion of a business trajectory will be used, replacing the flight plan in use today. The business trajectory is based on a 4-D flight trajectory supplemented with additional information describing the business attributes of the flight, under the overall coordination of a network wide traffic management.

The performance of the future ATM System will then be built around delivery of air traffic services which enable these trajectories, with all partners in ATM working to a common time reference and a common set of values and goals. The functional design of the System will have a coherent system-wide information management to facilitate the collaborative decision-making. The System will deliver air traffic services, which allow seamless enroute-to-en-route operations, integrating gate-to-gate performance and the airport turn-around process for best overall ATM System performance.

The future ATM System will be designed and operated to provide a quality of service, which maximises predictability and minimises the amount of variability within the constraints of the available infrastructure.

The results of Milestone 3 will be available on the www.sesar-consortium.aero web site in the summer of 2007 and will be presented to the air transport community during the D3 Stakeholder Forum on October 11th 2007 in Berlin, Germany.

6. OVERALL CONCLUSIONS

The air transport industry will continue supporting the mobility of citizens and economic growth in Europe. Air transport is a mature industry with promising capabilities for growth, though vulnerable to external events; hence the need to develop it in a sustainable manner.

The future European ATM System, implemented with a service-centric approach within a business framework, must be able to cope with the expected market growth and meet the societal requirements. It has to tackle the fragmentation associated with today's national structures and the associated restrictions, which constrain the industry from responding effectively and efficiently to the evolving challenges. There is a need for one simplified European framework together with a performance-based approach, which satisfies all airspace user requirements. States and Industry all have a role to play in ensuring that Europe's ATM System is progressively modernised to cope safely with the expected traffic growth.

Business as usual is not an option.

7. REFERENCES

[1] ICAO Doc.9854 AN/458 (2005) – "Global ATM Operational Concept"

[2] SESAR Consortium - D1 Milestone Deliverable (2006) – "Air Transport Framework - The Current Situation"

[3] SESAR Consortium - D2 Milestone Deliverable (2006) – "Air Transport Framework - The Performance Target"

8. WHO IS THE SESAR CONSORTIUM?

AEA (Association of European Airlines), Aéroports de (ADP), AENA (Aeropuertos Espanoles Paris Navegacion Aérea), AIRBUS, Air France, Air Traffic Alliance E.I.G / G.I.E, Amsterdam Airport SCHIPHOL, Austro Control GmbH, BAA (UK airport group), BAE Deutsche Flugsicherung GmbH (DFS), Svstems. Deutsche Lufthansa AG, DSNA (Direction des Services de la Navigation Aérienne), EADS, ENAV, ERA (European Regions Airline Association), FRAPORT, AOPA (International Council of Aircraft Owner and Pilot (International Air IATA Associations), Transport Association), Iberia, INDRA, KLM, LFV (Luftfartsverket), LVNL (Air Traffic Control The Netherlands), Munich International Airport, NATS, NAV Portugal, SELEX Sistemi Integrati, THALES ATM, THALES AVIONICS.

The SESAR Associated Partners are:ATC EUC, Boeing, CAA UK, ECA, ETF, EURAMID, IFATCA, IFATSEA, Honeywell, Rockwell-Collins, Dassault (representing EBAA), ELFAA

Research Centres: AENA, DFS, DLR, DSNA, INECO, ISDEFE, NLR, SICTA, SOFREAVIA.