ATM Research & Development

SESAR
The roadmap for the future
European air traffic management system

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Dear readers,

Few areas of civil aviation currently demand more sustained research and development than air traffic management (ATM), which is a pivotal concern for EUROCONTROL.

Planning the huge advances required for the future European ATM system can take place only within the spectrum of possibilities opened up by R&D activities and with the cooperation of the entire industry.

Cooperation is what our future is about and is our next big challenge. The Single European Sky ATM Research – SESAR – will require a great deal of cooperation among the members of the consortium, and at the same time good governance arrangements from the funding partners.

With traffic expected to reach 16 million flights a year by 2020, much more effort is needed in many areas of air traffic management in order to prevent an increase in delays and to maintain a good safety record.

The SESAR Definition Phase has started. This project will unite the ATM stakeholders around a common vision, with the development of a Master Plan for the creation of the future European ATM system. The Plan will have to be for a sustainable and high-performance system which all stakeholders can buy into, which is feasible and in which we are ready to invest in order to make it a reality.

Achieving this expectation is a challenge which SESAR must take up. EUROCONTROL can, however, help the partners in the SESAR Definition Phase by providing valid input into the overall deliberations. The work carried out by our Experimental Centre will be crucial in this. The Centre has been at the hub of ATM research and development for over forty years, supporting projects across Europe and coordinating R&D efforts at pan-European level.

Cooperative ATM (C-ATM) is one project which has contributed to a better understanding of the medium-term concepts of operations for the future ATM system in Europe, through the involvement of the major players in our industry, thereby opening the door to future paradigm shifts.

It is now the task of the SESAR consortium to analyse, adopt and improve the various concepts proposals, including those for C-ATM.

This joint approach to R&D stems from recommendations published in 2002 by the Performance Review Commission in its fifth Performance Review Report, which highlighted the fragmented and inefficient nature of European research.

The SESAR programme is a response to this need. SESAR should in fact help consolidate the fragmented approach to research by setting a common baseline from which to build, and that will provide the necessary quantum jump in ATM performance.

In addition to performing strongly today, Europe is in fact preparing to face the challenges which will result from the forecast robust growth in air traffic over the next twenty years. For this purpose, close cooperation and a common approach to research are absolutely essential and will continue to be of fundamental importance.

All of us in the industry today have the unique opportunity to move forward and expect even greater alignment of the R&D programmes which will validate the system for the long-term future, catering for sustainable air transport growth.

Victor M. Aguado
Director General

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Chers lecteurs,

Peu de domaines de l’aviation civile réclament un effort de recherche-développement aussi soutenu que la gestion du trafic aérien (ATM), activité phare d’EUROCONTROL.

La planification des avancées majeures que requiert le futur système ATM européen ne peut se concevoir que dans les limites des possibilités ouvertes par les activités de R-D et nécessite la coopération de l’ensemble du secteur.

La coopération sera le maître mot pour l’avenir, et notre prochain grand défi. Le Programme de recherche ATM dans le cadre du Ciel unique européen (SESAR) exigera une coopération étendue entre les membres du consortium et, dans le même temps, des mécanismes de bonne gouvernance de la part des partenaires bailleurs de fonds.

Alors que le trafic devrait atteindre les 16 millions de vols par an d’ici à 2020, des efforts beaucoup plus soutenus sont nécessaires dans nombre de domaines liés à la gestion du trafic aérien, afin de prévenir toute augmentation des retards et de maintenir la sécurité à un niveau adéquat.

La phase de définition de SESAR a débuté. Ce projet fédérera les partenaires ATM autour d’une vision commune, avec l’élaboration d’un Plan-cadre pour la création du système ATM européen futur. Ce plan devra viser la mise en place d’un système durable et performant, propre à rallier l’ensemble des partenaires et à offrir toutes les garanties de faisabilité, et dans lequel nous soyons disposés à investir pour qu’il devienne réalité.

La concrétisation de cette ambition est un défi que doit relever SESAR. EUROCONTROL est toutefois en mesure d’aider les partenaires engagés dans la phase de définition de SESAR en apportant des contributions utiles au débat général. Les travaux menés par notre Centre expérimental revêtiront une importance cruciale dans ce contexte. Véritable plaque tournante de la recherche-développement dans le domaine ATM depuis plus de quarante ans, le Centre expérimental appuie des projets dans toute l’Europe et coordonne les activités de R-D à l’échelon panéuropéen.

L’ATM coopératif (C-ATM) figure au nombre des projets qui ont contribué à favoriser une meilleure compréhension des concepts opérationnels à moyen terme du futur système ATM européen, grâce à l’implication des principaux acteurs du secteur, ce qui a ainsi permis d’ouvrir la voie à de futurs changements radicaux.

Il appartient aujourd’hui au consortium SESAR d’analyser, adopter et affiner les différents concepts proposés, et notamment celui du C-ATM.

Cette approche conjointe de la R-D découle des recommandations formulées, en 2002, par la Commission d’examen des performances dans son cinquième rapport sur l’examen des performances, lequel mettait en évidence la fragmentation et l’inefficacité de la recherche européenne.

Le Programme SESAR s’inscrit en réponse à ce constat. De fait, il devrait contribuer à réduire l’approche fragmentée de la recherche en définissant une plateforme de travail commune, qui permettra d’effectuer le saut quantitatif requis en termes de performances ATM.

L’Europe ne se contente pas d’afficher d’excellents résultats, elle se prépare également à relever les défis que poseront la forte croissance escomptée du trafic aérien au cours des vingt prochaines années. Dans ce contexte, une coopération étroite et une approche commune de la recherche sont absolument vitales et continueront de revêtir une importance fondamentale.

L’ensemble du secteur se voit aujourd’hui offrir une occasion unique d’aller de l’avant et d’espérer un alignement plus marqué encore des programmes de R-D qui valideront le système envisagé pour le long terme, au bénéfice d’une croissance durable du transport aérien.

Victor M. Aguado
Director General
The EUROCONTROL Experimental Centre (EEC) can trace its origins back to August 1960 and the establishment of the Bureau d’Etudes EUROCONTROL at Paris Orly. An Experimental Unit was created in October 1962, and two years later construction of the new Experimental Centre started at Brétigny-sur-Orge, to the south of Paris. The EEC was inaugurated in January 1967. Its primary orientation towards simulation was reflected in its organisation: along with an administrative section, its four divisions included a scientific and mathematical services division, responsible for software, and an engineering division, responsible for hardware. Both supported the simulations and trials division, which was responsible for operations.

The emphasis on simulation has persisted as successive generations of equipment have been used to address the developing requirements of air traffic management (ATM). During the 1960s, the Upper Area Control Centre (UAC) at Maastricht was the main focus for work, followed by the KARLDAP system for the Karlsruhe UAC and the SHANDAP system for Shannon. In 1970, the EEC’s ATC simulator was connected to the Concorde flight simulator in Toulouse in order to investigate the impact on air traffic control of the new supersonic airliner.

Continuing simulation work was accompanied by a growing number of studies addressing new concepts, techniques and equipment. They included evaluation of the potential for using commercial off-the-shelf (COTS) equipment for ATC, which became a reality in the 1980s with the introduction of new controller working positions, and development of the associated software.

The traffic growth of the 1990s and the measures adopted to handle it, such as the creation of the Central flow Management Unit (CFMU), demanded...
a corresponding increase in the Centre’s research-and-development activities. The European Air Traffic Control Harmonisation and Integration Programme (EATCHIP) and its successor, the European Air Traffic Management Programme (EATMP), became the umbrella for much of the Centre’s work.

That work was extraordinarily varied. It covered everything from air traffic flow management (ATFM) simulations to new concepts such as satellite navigation, height-keeping validation for the reduced vertical separation minima (RVSM) and the integration of Mode-S secondary surveillance and the airborne collision avoidance system (ACAS).

Now, however, all the disparate strands of research are being drawn together in support of the ambitious plan to create a Single European Sky (SES).

**Focus on 2020**

The signature on 22 November 2005 of the SESAR Definition Phase contract, with its focus on ensuring that EUROCONTROL is able to cope with the level of air traffic predicted for 2020, marked the start of a new era for the EEC. Preparations for the transition had, however, been under way for some time.

Pierre Andribet, the EEC’s Core Business Manager, says the Centre is in the process of changing from a traditional research establishment with a portfolio of projects in various areas to one whose activities are for the major part aligned along a single axis: “The main change is that we used to investigate technologies and new concepts; now we are more concerned with the operational validation of the 2020 ATM system.

“The new orientation stems from recommendations published in 2002 by the Performance Review Commission in its fifth Performance Review Report (PRR/5), which highlighted the fragmented and inefficient nature of European research. The EEC and Europe’s aerospace industry, represented by the European Association of Aerospace Industries (AECMA, now part of the AeroSpace and Defence Industries Association of Europe, or ASD) responded by developing a new initiative which gave rise to the SESAR programme.

“All the disparate strands of research are being drawn together in support of the ambitious plan to create a Single European Sky”

The main objectives of SESAR, Andribet says, are to foster a commitment on the part of all ATM stakeholders to the achievement of a common goal, and to ensure the transition from research to the validation, development and ultimately implementation of the systems identified. The Definition Phase, which is supported by a European Commission TEN-T grant, is
intended to identify the main components of the 2020 system and define the route to development and deployment.

“Our focus is less on technology than on the operational side, the core business of ATM – how the controllers and pilots will work together in the future ATM system,” Andribet stresses. The results may have an impact on the technology side, but “analysing the technology is not the role of the EEC; the role of the EEC is to develop a safe, efficient and environmentally acceptable operational environment, exploiting these technologies.”

Managing change

More than three quarters of the Centre’s 240 staff are engaged in research, so there has been no need for additional research staff, Andribet says. But the move from a multiplicity of small teams working on individual projects in various domains to what is effectively a single team working on one core programme has required some additional management expertise. So a handful of senior managers have been recruited, including some from elsewhere in the Agency.

The new work structure has required a parallel cultural change. “The average project in the past involved three or four staff,” Andribet says. “Now 80 or 90% will be working on the same programme, so it’s not the same mentality, it’s not the same culture. That is the main change which we have to implement at the Centre.”

The process, Andribet says candidly, has been a painful one. It involved first defining the strategy and then communicating it, initially to a layer of middle managers: “It’s a standard change-management process – organising workshops to think together, to win the support of the middle management, and after that to communicate to all the staff, globally to start with and then in small teams.” The communication is a two-way process, designed to involve as many people as possible in designing the work programme. Overall, the process will take two years, he estimates: “It started 18 months ago and it’s blossoming now.”

In terms of infrastructure, there has been a move to update the real-time simulator, with a shift away from the previous proprietary approach relying on in-house development. “It was a very proprietary simulator,” Andribet explains. “That has some advantages, but it lacked realism compared to the real systems. In the last few years, we have sub-contracted big components to the industry, so we have moved from a very closed, proprietary simulator to an open architecture using components from industry. This was one of the big changes we had to make, because the real-time simulator is one of the most important tools for the type of research we have to do.”
As the change process approaches completion, Andribet says, there is a new challenge to face: "Now we have to deliver". Work started in March 2006, and the R&D Master Plan and Work Programme which it is scheduled to produce will completely reshape the European landscape for ATM research. At the same time, the EEC will assume a new role in coordinating ATM research across Europe.

**Episode 3**

The Performance Review Commission’s 2002 Report identified a lack of coordination in European ATM research, resulting in redundancy, overlap and too little focus on results. A new project called Episode 3, which forms part of the European Commission’s Sixth Framework Programme, has offered the opportunity for the EEC to assist the various national research establishments to form a more organised and focused network in support of SESAR.

"We will not be managing the work programme in a dictatorial sense," Andribet says. "It’s collaborative management, but with Brétigny at the centre, so it’s a shift in terms of organisation." In the past, the individual centres exchanged ideas and results, but the aim now is to organise their work around the same programme, namely SESAR.

The precise objectives of Episode 3 are:

- to confirm the target levels of performance in the key performance areas as identified within the SESAR definition phase;
- to provide evidence of the performance of the operational concept against these targets;
- to ensure that the resulting operational concept is “safe in principle”;
- to provide evidence of the operational and technological viability of the resulting target concept;
- to consolidate and deliver the specifications of the target operational concept in accordance with validation results.

The project involves almost all the players of the European research network and the ATM supply industry and also ensures the active involvement of major operational actors from European air navigation service providers, airports and airlines.

The EEC expects to establish strong synergies and cross-fertilisation with SESAR throughout the project lifecycle, and particularly at each of the five major project milestones, thereby ensuring the applicability of its focus and results.

The project has been built to ensure flexibility, incorporating SESAR findings as these become available. The basic philosophy adopted by Episode 3 is to organise validation and assessment activities in two iterations, with a major milestone at the end of the first iteration. This will serve to consolidate the results of the first iteration, to refine and amend the target operational concept accordingly, and to launch a second iteration within key European operational environments for the further validation of the concept.

"It is a preparation or foundation-building for SESAR, where the EEC is leading the programme in which all the research centres and the supply industry are partners," Andribet sums up. "It is the first stage of a rocket that will lead to a major integrated programme of activities where the research work programme ultimately leads to full deployment and operation. The start of this project makes 2006 a real turning-point for us, because we will have to build the network of research centres and, together with the supply industry, work towards common goals within the same work programme."
We often hear that air traffic management (ATM) research has not delivered anything for the last thirty years despite the fact that Europe spends about €200 million every year on it. How do you, as a leading member of the ATM research community, respond to such a statement?

With such a question I am of course tempted to point to the title of this interview: “Research drives the future”. I can also point to a number of studies which all show that investment in R&D brings great benefits. The healthiest economies are always big R&D spenders. In the past, there has been an element of vision behind this, but these recent studies quote a very positive return on R&D investment. The negative element, however, is that cost-benefit analyses mostly span a horizon of between five and ten years, and look where we are today. Data-link research started in the eighties but application has only just started on a very limited scale, whereas in exactly the same period the Internet has completely changed the lifestyles of the younger generation. So although we are way behind, the R&D on “the Internet in the sky” is dramatically changing the way we organise the traffic.

There are well-known examples which illustrate that vision is far more important than cost-benefit analyses. Jet-engine R&D started well before World War II and the US Air Force had even rejected the concept as being not promising enough, and look where we are today. Data-link research started in the eighties but application has only just started on a very limited scale, whereas in exactly the same period the Internet has completely changed the lifestyles of the younger generation. So although we are way behind, the R&D on “the Internet in the sky” is dramatically changing the way we organise the traffic. TCAS R&D resulted from a congressional decision (or was it a “vision”?); it was pushed ahead in the eighties and has now finally been introduced in Europe, making possible RVSM and thus a capacity boost together with the necessary safety boost. But was the RVSM cost-benefit analysis part of the decision to launch TCAS R&D?

The University of Sussex published an interesting historical analysis about the major steps in our industrial revolution. The steam engine, electricity, the computer (to name but a few) all have in common that they went through a twenty to thirty year R&D phase, with limited application and focus on development before they reached maturity. Thereafter there was an explosion of applications, which changed the world.

The vision of putting a man on the moon, although probably also inspired by Cold-War rhetoric, has greatly contributed to a faster development of space, computer and control technology. Its economic impact turned out to be enormous, but I have never seen a cost-benefit analysis on it. Where would we have been in ATM without the human/machine research, the tools that came into use, the radar R&D? Elsewhere in this Skyway you will find other examples of what research has delivered and I could fill this issue with more examples. Do you really think that we could handle today’s traffic with just the simple radar screens of the sixties? Everything which came later and which makes up the ATM system of today has been preceded by R&D. So I can safely say that I have no fear of cost-benefit analyses, looking at the past thirty to forty years of ATM R&D.

Jan Van Doorn, the Director of the EUROCONTROL Experimental Centre since June 2005, who explains how research drives the future.
We know that history has an annoying habit of repeating itself. Is there really anything new in the Cooperative Air Traffic Management (C-ATM) concept, and can it really deliver the future ATM system that Europe needs?

C-ATM is of course not a magic silver bullet that solves all problems. Numerous ideas have shaped the thinking. The Performance Review Unit for example has pointed to the gains deriving from better and more information available to all players.

I remember my old friend Klaus Platz from the DFS proposing a “layered planning concept” back in the nineties, not to mention the EATMP* Air-Ground Cooperation Programme which gave birth to the PETAL trials and the subsequent Link 2000+ (data-link implementation) Programme. It also spurred the thinking on CDM and SWIM*. So a lot of “C-ATM elements” were already in the air.

The point about C-ATM is that it has brought together many stakeholders (who, by the way, are now also working together in the SESAR consortium) in developing a medium-term concept of operations, which happens to be largely aligned with the more long-term operational concept of the ATM 2000+ strategy of the EUROCONTROL Organisation.

It is a concept that at least has a lot of supporters and it opens the door to future paradigm shifts. This last point is important for me as a researcher but also for the future of ATM. It anticipates the 4-D trajectory concept as an important enabler for organising traffic, and the delegation of responsibility for separation to the cockpit as a first step towards further air-ground cooperation. So it could (if SESAR embraces it either fully or in a modified way) represent an intermediate step towards a more advanced concept with a larger paradigm shift. Most players (with ACARE SRA in the lead) do think that such a change is necessary in order to cope with the predicted traffic demand.

Over the past decade European ATM research has seen widely dispersed research funding and fragmented research. How will the measures now being put in place in Europe ensure a real focus on the common European vision? After all, the issue here is also one of culture and mind-set.

In the past we had a number of independent nations in Europe, each capable of having its own aeronautical industry competing on the world market. Gradually the world has evolved in larger economic entities and it was only recently recognised that Europe should try not only to present itself as a single economic entity but also to create a single European sky and have, as a single European entity, common aviation agreements with other comparable entities (USA, Russia, China, etc.).

Moreover, since defence is still largely a national responsibility, aeronautical (and ATM) R&D tends to follow the unification process rather slowly.

The good thing is that this has led to cultural diversity and competition between ideas, which in turn has stimulated creativity – an excellent baseline to build upon for the future, I should say. Using this baseline we must be able now to build a strong united vision. Taking the best of several ideas will most probably deliver more than single-channel research.

National budgets (an element in the fragmentation) are shrinking. The combined EC-EUROCONTROL R&D programme encompasses about 80% of the European budget for ATM R&D, and the Joint Programme Board coordinat- ing between the two is really taking off.

The Experimental Centre so- wed the seed of the ATM Master Plan, which was the catalyst for SESAR. How is the Centre preparing itself to take on the role of leader and manager of ATM research in Europe?

The EC is pushing for less fragmentation in Europe. So the trend is towards more focus and centrally-led development making use of the strong multicultural creativity of Europe.

In such an environment, somebody has to be the conductor of the orchestra (I like to use this metaphor) in order to create a harmonised tune.

“The C-ATM concept opens the door to future paradigm shifts”
Skyway speaks to Jan Van Doorn, the Director of the EUROCONTROL Experimental Centre

I see the various research entities in Europe as specialists, becoming centres of expertise in limited areas of the ATM R&D field, like the different instruments in the orchestra. In my opinion, which is supported by the EC, the EEC has a central position and is this natural “conductor”. We have the size and the quality to perform this task.

It will, however, mean a role change. The Centre will do less R&D, but will be more involved in coordinating, federating and managing the work spread out between the different centres of expertise in Europe. So we have to rebuild and expand our current network of research entities in Europe, where the focus is on applied research, and also embrace universities, where the focus is on innovative research. This is an indication of the direction in which we are going.

How does Europe get out of the comfort zone of short- and medium-term research and move over to the real challenge of long-term research? Despite the pioneering work of ACARE, real funding and planning of long-term research seems to be strangely absent in all the SESAR euphoria.

I am not at all surprised or annoyed by the direction that SESAR is taking. After all, the underlying thought was that we need an agreed deployment master plan on which to “graft” the research. As long as SESAR is willing to open the door to the future, I foresee no problem. I cannot honestly imagine that the consortium will close that door. Indeed ACARE has already pointed to the challenges ahead: pilot-less freighters based on further development of unmanned aerial vehicles (UAVs), and the growing concern about airports becoming the real limiting factor if we don’t foster paradigm changes in air transport and ATM. I am thinking, however, of the developments in society over the last twenty years: mobile phones, the Internet, computers everywhere! Most of these had never been foreseen. So I guess the same will happen in our ATM world. We only have to have the courage to “think outside the box” – and we will.

To begin with, we don’t need big budgets. The PHARE* project (all about 4-D trajectory concepts) took about €10 million per annum, 5-6% of the total European budget. Ahead of its time in the nineties, it became the founding father for the Boeing concept, the C-ATM concept, and subsequently the SESAR concept. Twenty years on from these “brainwaves”, we face the challenge of creating new brainwaves for the 2020-2030 time period.

I would therefore advocate setting up think-tanks, brainstorming sessions or “red and blue” teams using small budgets just to stimulate “out-of-the-box” thinking. We would then have to pioneer a number of the ideas to see which ones can be matured and have potential.

Finally, as an experienced member of the research community you must have some thoughts about future direction. What do you see as being the big concept challenges for the air transport system and who are likely to be the main players in pushing these challenges forward?

Although flattered by the word experienced, I must confess that I don’t believe too much in it. I believe young people are the best innovators. Experienced people tend to be weighed down by their experience and tend to see too many pitfalls to create revolutions; and we need a revolution, implemented in an evolutionary way. So I am the wrong person to answer your question. However, I cannot of course resist the temptation to speculate a little bit.

Humans are not strong in tactical actions, they are better in strategic thinking and creative decision-making, even if they do not always know exactly how and why, they do find a solution. So leave the tactical, repetitive elements to the machines.

Especially in the more steady phases of flight, the machines on the aircraft, managed by the pilots, will do the job. The controllers will be more necessary in the transitional flight phases but also in more planning and system-managing roles.

We will see a move from single aircraft control to creating fleets that will be controlled, and individual aircraft will be visible only when they enter or leave the formation. We will see specialised “highways”, comparable with TGVs, for high-density transport. Further in the future, in the second half of this century, I could envisage what I describe as “cruisers”, large aircraft that constantly circle the earth in certain patterns, which you can enter with your personal small craft via a docking procedure in the air.
Such a link needs to be improved in order to make research an effective instrument supporting the modernisation of the European air traffic management system. This aspect is closely connected to the issue of governance in ATM R&D. Advances made in the last few years in this respect have been considerable and a practical structure is now in place – ready to foster the R&D part of the ATM Master Plan.

The main aspects to be taken into consideration are:

- **R&D needs:** what has to be validated; a dialogue between planners, operators and researchers is vital, based on the understanding of the problems to be solved;
- **the observation of ongoing activities and progress:** how the needs are met;
- **the exploitation of accumulated knowledge:** to prevent experience being lost, but also to exchange, compare and supplement experiences;
- **the process and guidelines for projects:** dissemination and consistent use of good practices;
- **the budgets and their availability:** levels commensurate to the problems to be addressed, balanced contribution of the different stakeholders;
- **the research teams:** develop, maintain and exploit competences; who is best suited?
- **the cohesion and completeness of the programmes:**
- **some room left for innovation.**

It is worth recalling how these aspects have been addressed through a number of initiatives, which all contributed to the current approach.

**Twenty years of R&D coordination**

It was only in the mid-80s that European ATM R&D establishments got together to exchange information on their respective programmes and envisaged a common approach. PHARE, the Programme for Harmonised ATM Research in EUROCONTROL, was launched in 1988 with the ambition of demonstrating the benefits of exploiting Flight Management Systems’ (FMS) four-dimensional trajectory data, using experimental aircraft and ground simulators.

In the context of the 4th Framework Programme, the European Commission (EC) organised its internal coordination (ECARDA: European Coordinated Approach of R&D in ATM) and took the opportunity to invite Member States and EUROCONTROL to join in and share R&D project information. However, the idea of a common plan was not mature enough at the time and the EC was not provided with information relating to national programmes.

Subsequently, in the mid-90s, the EUROCONTROL ATM R&D Review Group, which was involved in discussions on implementation planning and it was therefore difficult to formulate or implement any recommendations in the absence of a formal process.
ARDEP is set up shortly afterwards to monitor ATM R&D. As a result we now have over ten years’ worth of records covering R&D projects. In parallel, and in synergy with projects from the 5th Framework Programme, progress was made towards the definition of common understanding, methodologies and guidelines for validation, recognising that one of the main objectives of R&D is to help decision-making through structured reasoning.

Master plan genesis

This was also the time when initial ideas on the need for reinforced links between ATM and the rest of the aeronautics and supply industry were formulated.

“The notion of a European Master Plan can only make sense in the perspective of the full life cycle up to implementation in order for the research efforts to be connected to needs”

In 2000-2001, a net acceleration was perceived with the publication of the ATM2000+ Strategy, the work of the High-Level Group and Vision 2020. These coincided with the start of the EC’s 6th Framework Programme.

Against this background, the Agency took the opportunity to reinforce the dialogue with the ATM industry through AECMA (the European Association of Aerospace Equipment Manufacturers, now ASD – Aerospace and Defence) and seek better alignment of the projects within the 6th Framework, in line with its European Air Traffic Management Programme (EATMP). At around the same time the industry, as represented by the AECMA Board and the Strategic Aerospace Review for the 21st century (STAR 21), recognised the need to establish a Master Plan on ATM development and investments, as initially proposed in the Single Sky High-Level Group Report and in the 2002 5th PRC report (See also STAR 21 Report published in 2002).

While the notion of a European Master Plan was first discussed from an R&D perspective, it soon became obvious that it could only make sense in the perspective of the full life cycle up to implementation in order for the research efforts to be connected to needs and therefore able to fill the observed gaps. In this vein, such a Master Plan could be seen as a plan for investment cycles and their timing, on which industry could base its development activities (and airlines and air navigation service providers’ investment plans).

A more formal cooperation body, known as the EUROCONTROL/AECMA Bilateral Steering Group, began meeting in 2002 and focused primarily on:

- cooperation on the definition of the 6th Framework Programme;
- developing the Master Plan together;
- cooperating on the ACARE SRA and giving support to the ACARE process.

While EUROCONTROL was fostering/supporting the idea of an ATM Master Plan, the industry, through the continuation of the STAR 21 discussions, emphasised budgetary aspects, generated proposals for handling the topic and started to approach the EC. We worked with them till mid-2003 to prepare initial supporting material.

In these preliminary thoughts, it was deemed important to stress that all topics cannot be addressed in the same way but differ according to their level of maturity and the application timeframe, and that a limited series of clear steps for change was necessary in order to communicate the evolution of ATM, corresponding to identifiable products for the different stakeholders. Three notional stages were identified for the progressive implementation of the underlying operational concept vision for 2020:

- 2007 – Foundation: in the shorter term there is no time to undertake new research; available options need to be confirmed and then implemented;
- 2012 – Single European Sky deployment: although options have been identified for the medium term, they need to be the subject of extensive validation so as to envisage their timely implementation and application in industry; they require a well organised overall plan;
- 2017 – Collaborative high-performance ATM: in the longer term there is still time to explore more innovative options, but nevertheless with a view to narrowing down the alternatives and concentrating on those that deserve a more detailed validation.

These stages correspond, from an R&D perspective, to specific goals, purposes, tools, and ultimately decisions; at least as a means to a simplified message and picture, and will hopefully make it easier to improve the focus of efforts.

All these ideas have been injected into SESAR since spring 2004.
R&D governance

Bearing in mind that the Master Plan will contain an R&D facet, progress had to be made on its organisational set-up. Two facts acted as principal drivers:

- the accession of the European Community to EUROCONTROL; the Memorandum of Cooperation of December 2003 between the European Commission and EUROCONTROL identifies R&D as a priority area for cooperation;
- the observation that a growing majority of R&D spending relates to projects funded by EUROCONTROL and the EC. This gives a leverage mechanism that can greatly facilitate synergy, and also attract other sponsors.

The governance structure is based on the following:

- a common European research master plan, integral part of the ATM Master Plan to be delivered by SESAR;
- the Joint Programme Board (JPB);
- the standard use of instruments such as: ARDEP as a monitor of projects; the Validation Data Repository to store the objectives and conclusions of past and current projects; the OCVM (Operational Concept Validation Methodology) and similar system engineering methods that will be agreed during the SESAR Definition Phase;
- the coordination of the 7th Framework Programme and the EUROCONTROL research plan, including through the SESAR mechanisms to be established.

Joint programme board

The Joint Programme Board (JPB) was set up under the European Commission and EUROCONTROL Memorandum of Cooperation. The purpose of the JPB is to increase cooperation on ongoing research and support the implementation of the ATM component of the ACARE Strategic Research Agenda and the research part of the European ATM Master Plan by developing a joint approach to ATM research carried out by the European Commission and EUROCONTROL while ensuring complementarity, avoidance of duplication and optimisation of resources.

The JPB comprises representatives from the European Commission (DG Transport & Energy and DG Research) and the EUROCONTROL Agency (Headquarters and Experimental Centre).

It coordinates ATM research and technological development at the European Commission and the EUROCONTROL Agency. It will propose priorities to the decision-making bodies at the EC and EUROCONTROL and will consult with stakeholders. The JPB has met since October 2004, holding four meetings a year.

R&D coordination and SESAR

The R&D Master Plan is an integral part of the European ATM Master Plan. It will, for the first time, assemble a comprehensive picture of what has to be done to validate the future ATM system. Its integration in the overall plan will also ensure that development and implementation needs are supported by timely, relevant research, and that R&D results are fed directly back into the plan itself.

Applied in the full SESAR Programme, this will:

- bridge the gap between R&D and implementation through a better reality check and a better coupling of implementation planning and R&D planning;
- be instrumental to harmonise the awareness of the various stakeholders, maximising the use of available knowledge and speeding up decision-making;
- have a positive impact on the coordination, organisation, execution and effectiveness of R&D as a precursor to implementation, as well as on Europe’s ability to reinforce its human and technical research potential.

In conclusion, we are at a turning point for ATM. European ATM R&D has the mission and the capability to accompany that change. However, it will need to adapt itself to the evolving context as well as to the challenges facing the ATM system.
Focus

Research and validation: The foundation of progress

Introduction

A quick journey through the history of air traffic management in Europe shows that significant improvements have always been based on the results of continuous research.

The founding fathers of the EUROCONTROL Organisation in the late 1950s were already aware of this. On 15 April 1960 the third report by the EUROCONTROL Technical Working Group (representing Belgium, France, Ireland, Luxembourg, the Netherlands, Germany, and the United Kingdom and chaired by René Bulin), which proposed the creation of the EUROCONTROL Agency, specified that it would start with a transitional phase involving the implementation of a Planning Directorate and an Experimental Unit. The mission of this Unit is described in the report: An adequately equipped experimental unit whose duties consist in evaluating techniques prior to their integration into the EUROCONTROL ATC system should be made available for this Planning Directorate.

And indeed, most of the new concepts, tools and facilities that have been implemented over the last 50 years came from innovative ideas or from the use of new technologies which could be adapted to improve ATM. They have been developed and evaluated through detailed applied research, and their implementation could only be achieved safely and efficiently after a validation process, which was at times lengthy but always indispensable.

Some historical examples

All areas of ATM provide examples of this process.

Operational ATC centres have made extensive use of results from applied research and validation, in particular by running the real-time and fast-time simulators at the EUROCONTROL Experimental Centre (EEC), and this of course also applied to the centres developed by EUROCONTROL.

The very first EEC report, published in February 1963 (one month before the Convention officially came into force), showed the results of the simulation trials of EUROCONTROL Sector 3, Brussels, which had been implemented in partnership with the Experimental Unit of the UK’s Air Traffic Services. This was the first contribution to the development and implementation of the Maastricht Upper Area Control Centre, and was certainly not the last.

Other contributions have included not only studies into the operational organisation of the future Centre, but also the validation of the use of remote radar data and new technical tools, as well as evaluation of the future system and its planned capacity. The Karlsruhe and Shannon Upper Area Control Centres also benefited from studies and simulations run at the EEC throughout all their development phases.

In fact, research and validation were necessary for the development of all ATC centres, not only those developed by EUROCONTROL. In partnership with its stakeholders, the Centre has carried out studies and simulations for almost all European ATC systems, helping managers to organise their operations, select the best options and validate their implementation plans.

On a more general level, intensive research led to improvements in the methods and tools used by controllers. To list but a few: validation of radar data, multi-radar tracking, navigation accuracy, coordination methods, aircraft trajectory prediction, conflict detection, air-ground data link, and satellite navigation, were all studied in detail by the EEC in partnership with its stakeholders. The results, published in multiple reports over the past four decades, provided a solid basis for the corresponding implementation programmes.

Studies on forecasting and predictability were also carried out, starting in the late 1970s. They were further developed at the beginning of the 1980s and provided an important input to the implementation of air traffic flow management. The development of the EUROCONTROL Central Data Base, which eventually became the Central Flow Management Unit (CFMU), received (and still receives) ongoing support in the form of the research and validation being carried out at the Experimental Centre.

Three typical cases

For a better understanding of these contributions, let us consider three typical cases in a little more detail: the controller working position, Reduced Vertical Separation Minima (RVSM) and the Future ATM Profile (FAP).
One of the most important ATC research areas studied in depth at the EEC, as well as at other research centres, has always been the human factors domain, in particular the man-machine interface. In this context, the potential use of new technology, developed mainly in the IT (Information Technology) domain for the ATC environment, was explored in the late 1970s and 1980s. Several EEC reports were published evaluating the new displays, and in particular the use of colour coding for ATC data. Continuous development in this area and intense cooperation with other research centres in Europe and North America led to the development of the ODID (Operational Display and Input Device) programme in the late 1980s. After the development and evaluation of several generations of prototype ODID displays, this concept has now become the de facto standard at all modern ATC centres.

Studies on navigational accuracy have also run parallel to the history of the EUROCONTROL Agency. EEC report No. 2, published in March 1965, is entitled (in French): “Détermination des performances du système de navigation HARCO®”. In October 1972, EEC report No. 59 was published: “Effect of variation of Radar Separation Minima on the number of potential infringements”. The idea of possibly reducing separation minima as a means to increase capacity was followed by many studies on navigational accuracy and aircraft height-keeping stability, as well as those on the quality and reliability of radar data provided to the controller. The results of these studies, together with those carried out by other research centres in Europe, provided a firm basis on which to launch the RVSM programme. During its development phase, the EEC constantly contributed to the study and validation of the potential implementation options. It did so by running a series of simulations, starting with the NAT project (Northern Atlantic project, EEC Report No. 284, July 1995), followed by six large-scale real-time, and several fast-time, simulations for the Continental RVSM programme. The results produced were essential for the safe operational implementation of RVSM in 2002, recognised as the greatest improvement in ATC capacity in Europe. Thereafter, several studies were carried out in particular to assess the mutual impact of RVSM and TCAS®.

In the 1990s the need for a definition of high-level strategic performance indicators emerged and in 1996 the EUROCONTROL Experimental Centre launched the Future ATM Profile (FAP) project. The FAP model determines air traffic control capacities using the CFMU’s operational data and for every European air traffic control centre calculates the optimum operating point where the best compromise is provided between cost of service and cost of delays. Initially developed to support the Performance Review Unit, FAP has become the main instrument for the pan-European capacity planning process established in 1998 to support the Director General’s Consultation and Advisory Groups in strategic ATM planning. It also supports the CFMU with short-term projections of the effects of critical events, such as major traffic changes and capacity shortfalls, on ATFM delays in Europe. Moreover, this project shows that the long implementation timescales for ATM research can be shortened.

What next?

A new challenge faces all European partners. The objective of the Single European Sky, as stated by the European Commission, is “to treble ATM capacity, improving safety by a factor of ten, while reducing the environmental impact by 10%”. This is the very ambitious goal of SESAR, the Single European Sky ATM Research programme, whose acronym alone shows the fundamental importance of research as the key factor for its success.

With now more than forty years’ experience in research and validation having contributed to improving safety and efficiency in ATM, the EUROCONTROL Experimental Centre has realigned its work programme with SESAR and is ready to take on the role of an R&D managing agent, leading the validation of the target concept and ensuring that the R&D Programme delivers.
“It was a rainy day in Paris when Horst Hering, on his way to the Experimental Centre, turned on his car radio and suddenly focused on the fact that the name of the radio station was displayed on the radio console instead of the frequency.

A new idea went through his mind: why couldn’t we do the same for pilot-controller communications? What if aircraft call signs were transmitted in a similar manner?”

The technology used in radio broadcasting of frequency-based text identities known as Radio Data Systems (RDS) is already part of life, but applying it to air traffic control was a new idea, indeed an innovative one. An aircraft call sign could be automatically broadcast whenever a pilot used his radio, and that information could be displayed on the controller radar interface so that controllers would know who was talking. Spelling errors could be avoided, thus making the system safer.

Such an idea is innovative, but innovative research doesn’t stop at the level of the idea. It needs to address all of the following questions: How are we going to make it happen without creating additional workload for controllers and pilots? What is the best technology to use? How far can we go with the technology? Will there be any other application? Is the application feasible, not only technically but also operationally and economically?

Innovative research needs to assess whether the investigation concerns a technology or a new operational concept. As a matter of fact, when Horst arrived at the Centre that day, a short meeting was convened to discuss the idea. A week later, Horst identified the watermarking technology widely used in media protection as a candidate for the application. Two weeks later, Horst contacted a renowned laboratory, the Laboratory for Signal Processing at the Technical University of Graz, Austria. A visit followed and the EEC and Graz University started to work together.

Project AIT (Aircraft Identification Tag) was launched. Three months later, industry joined the team in order to implement the hardware needed to encode and decode the call signs that were tagged in VHF radio communications. Testing and validation were carried out to demonstrate the feasibility and identify the limitations of the proposed idea. Nine months later, at the ATC Maastricht exhibition, the team won the Innovation Award. Another six months passed before a project was initiated at EUROCONTROL Headquarters to study the operational implementation of AIT.

The story is not yet over. The initial idea has now been expanded to investigate the possibility of including position-reporting in the UHF and VHF channels, looking into the possibility for oceanic flights of reporting their positions through frequency channels, and consequently reducing the separation standard to less than the current 60 nautical miles.

This is a success story for innovative research, but not all studies come to a similar end and this is the nature of such research.

Innovative research at EUROCONTROL

Established in 2000, the major objective of innovative research has been to undertake experimental studies, the results of which are designed to help
clarify initial ideas for transfer into more focused research in the framework of future editions of the ATM R&D Master Plan. However, innovation is actively promoted at the EEC and this work package ensures that innovative ideas applicable in the short term are equally mastered and promoted.

The innovative research activities are complemented by ample dissemination initiatives with a view to obtaining maximum benefit from critical dialogue within the ATM community and transferring early feasibility results to strategy, concept development and research entities within the Agency.

The Experimental Centre

At the heart of European ATM innovative research

The EUROCONTROL Innovative Research Annual Workshop has seen substantial growth in the number of participants from industry, air traffic service providers, universities, research institutions and airlines. This fact testifies to the federating role of EUROCONTROL in innovative and long-term research.

One key component of this role is the CARE Innovative Research Action, originally created as part of CARE, Collaborative Action for Research in EUROCONTROL, under which innovative ideas to improve air traffic management, either technology-based or operational-based, are promoted for further investigation by a partnership accompanied by expertise and a financial funding scheme. Average annual funding of €500,000 is reserved for such bottom-up innovative investigation.

Leading the long-term research network

Air transport in general, and air traffic management in particular, are cross-domain disciplines which require knowledge from various fundamental disciplines such as economics, psychology, flight physics, mathematics, and also technological disciplines such as computer engineering, electronics, telecommunications, etc.

Progress made in ATM often comes from operational knowledge and is supported by knowledge and progress made in other fields. ACARE*, which recognises the needs for future-oriented backbone thinking, recommends the development of a research network as being instrumental for the future air transport system. In this perspective, the EEC is working with a network of academic and research institutions in order to establish EUROCONTROL Joint Research Laboratories (JRLs).

As part of the research network, each laboratory deals with a specific air transport topic, and the research interests are shared, with staffing input from all the partners. The first JRL was created with the Ecole Pratique des Hautes Etudes (EPHE), Sorbonne, Paris, on the subject of complex system modelling and cognitive sciences at the end of 2004. It is co-located at the EEC and at EPHE.

A call for tenders will be issued in 2006 to launch two new Joint Research Labs, one on airline and airport operations, the other on human-machine visualisation and interaction technologies. These progressive steps are part of our approach towards achieving a key EEC strategic objective – the development of an academic network to form the backbone thinking for the future of ATM in Europe.

“"A key EEC strategic objective – the development of an academic network to form the backbone thinking for the future of ATM in Europe”

Experiments and studies

The major role of the Innovative Research Area (INO) at the Experimental Centre has been to complement the top-down strategies in EATM and recently SESAR and the ACARE Strategic Research Agenda (SRA) through exploratory studies based on lateral thinking and a bottom-up approach, and through cooperation with universities, research institutions and industry. Study topics are aligned with the ACARE/SRA perspective in order to complement identified emergent key components of future systems.
All innovative activities are reviewed and possibly reoriented at the end of every year by the Innovative Research Advisory Board, composed of ATM research strategists from the European Commission, EUROCONTROL and external scientists.

Through partnerships with universities and research institutions, all studies follow an experimental validation methodology, focusing on technical and operational feasibility assessment, in which the human safety management role is a principal component. Most studies are aligned with topics suggested in the ACARE Strategic Research Agenda, such as innovative visualisation techniques, highly automated ATM, and tower-less ATM. More than twenty studies, more than half of which constitute doctoral research, are currently being conducted and fall into three strategic research domains: Advanced Operational Concepts, Emergent Technologies for ATM and Analytical Modelling of ATM Operations.

Aligned with the ACARE Strategic Research Agenda, key lines of research include: (i) Future Airport concept which may lead to the separation of terminal constraints and runway constraints, and could result in a new concept of networks of airports integrated into an overall air-rail multi-modal transport system; (ii) Synchronous and Highly Automated ATM with studies targeting a paradigm shift from the current sector-based non-synchronous control to synchronous control with different approaches: larger volumes of airspace, city-pair 4D tubes, impacts of speed control on the overall ATM, and a dual system of 4D contracts in regulated sector-based airspace; and (iii) ATM for New Vehicles with doctoral studies to investigate the impacts of and potential solutions for the growth of small business jets and unmanned automated vehicles (UAVs) in the European ATM system.

Emergent Technologies for ATM includes investigations of an experimental and empirical nature on the application of emergent technologies to ATM operations, with the ultimate goal of making improvements to current ATM systems. In line with ACARE SRA, three major technological research themes are being investigated: (i) augmented and virtual reality technologies for ATM visualisation using 3D stereoscopic and head-mounted see-through displays. Target applications include tower-less control, enhanced visualisation for tower control, and approach area control; (ii) multi-modal interaction technologies with voice, gesture and other input/output devices which may allow enhancement of situational awareness and/or increase controller productivity. Current studies include the extension of digital watermarking technologies in pilot-to-controller VHF communications in order to include position reports of oceanic flights; and intelligent interfaces for time-based strips (VITAL) and dynamic flight level displays (WHEELIE); (iii) security of voice, digital, and system communications with non-intrusive but safe encryption technology such as quantum encryption and interactive code-changes.

Analytic Modelling of ATM Operations focuses on analytical modelling of the nature and operations of ATM with a view to obtaining a better understanding of the stochastic nature of ATM operations, from ATFM planning to ATC tactical actions. The ultimate goal is to better fill the gap between the predictive components of ATFM and the adaptive components of ATC actions. Two major areas on which the research is focusing are: (i) understanding and mastering uncertainties through research on models to capture the stochastic nature of ATM; and (ii) modelling the holistic ATM in terms of complex system modelling with the aim of achieving a more scientific foundation for ATM components such as capacity and workload.
Thus was born the CEATS Research, Development and Simulation Centre (CRDS). In many ways, the CRDS contributed to the entire CEATS Programme. While the CEATS Strategy, Planning and Development Unit (CSPDU), based in Prague, manages the complex technical, operational and contractual implementation of the CEATS work programme, the CRDS provides the validation simulations and additional improvements and innovations to the advanced concepts on which CEATS depends.

Managed by Philippe Debels, the CEATS Research, Development and Simulation Centre’s small team has three core functions. First, it carries out ATM simulations aimed at further improving and subsequently validating the airspace structure, advanced ATC concepts and tools supporting the air traffic controllers.

The simulations can be either model-based, where a mathematical model is used to study the air traffic system, or real-time with the active involvement of air traffic controllers from the CEATS States. Both simulations make use of traffic samples built on the basis of the latest STATFOR forecasts and macroscopic traffic flow simulations, coordinated with the Airspace Flow Management and Navigation Unit at EUROCONTROL’s Brussels headquarters.

The second core function supports the training of future CEATS air traffic controllers. It also makes use of the real-time simulator and focuses on specific CEATS concepts such as advanced civil-military coordination, multi-executive sectors and cross-border sectors. In this context, the CRDS works not only with the CSPDU in Prague and the Institute of Air Navigation Services in Luxembourg but also with the CEATS Region national air navigation service providers.

Finally, promising ATM research and development initiatives are being launched in close cooperation with Central European universities. Since 2001 the CRDS has successfully coached about 30 PhD or MSc students from Budapest, Graz, Žilina, Belgrade, Padova, Trieste and Dresden. The next objective is to build a network with these universities in order to foster mobility of researchers, dissemination of knowledge and inter-university cooperation, thereby contributing to innovations in ATM.

The CRDS’ reputation for excellence is beginning to expand beyond the boundaries of the CEATS States. Simulations and studies have already been or are being conducted not only in support of the CEATS Programme, but also for other European projects such as Link 2000+ and air navigation service providers in countries such as Slovenia, Hungary, Croatia, Serbia and Montenegro, Norway and Greece.

CRDS maintains a close relationship with the EUROCONTROL Experimental Centre, which was instrumental in the implementation of the CRDS and training of its staff. Currently the two centres are looking at further development of the simulator platform and coordination of the research activities of PhD students.

Together with colleagues from the CSPDU in Prague and ATM experts from the regional air navigation service providers, and in close cooperation with the Experimental Centre, the CRDS is working on a possible contribution to ATM validation activities in support of SESAR and other European projects such as Episode 3.
Introduction

Let me start with a simple statement rather than a precise definition. “Aircraft and ground systems should implement air-ground data communications and services in order to increase safety and efficiency in the air traffic management network”; this is known as data link.

This statement seems obvious, and data link has been widely implemented in every walk of modern life for both business and leisure purposes. Up to now, however, data link connecting aircraft and ground has not been widely implemented in the world of ATM, although it is identified in every major ATM strategy as a key component required for future improvements. As far back as 1987, the Future Air Navigation System (FANS/3 Report, Doc. 9503) was approved by the ICAO Council. It identified a requirement for data link in 2010 and beyond. This need was further reinforced by the Agency’s own ATM 2000+ Strategy.

The path to implementation from concept and R&D has been long and complex, spanning many reorganisations; this article charts the major milestones along the way.

The biggest challenge following system validation has been to convince aircraft operators and air navigation service providers to synchronise investment in order to deploy for mutual benefit. This difficulty may in future be resolved by means of the Single European Sky implementing rules. The EUROCONTROL Regulatory Unit is currently developing a data-link implementing rule, following a mandate received from the European Commission in May 2005.

What is Link 2000+?

The LINK 2000+ Programme packages a first set of en-route controller-pilot data-link-communication (CPDLC) services into a beneficial and affordable set for implementation. The R&D has been carried out, the standards are stable, the safety case is mature and the business case justifies it. CPDLC is already operational at the EUROCONTROL Upper Area Control Centre in Maastricht, with roll-out throughout the LINK region (see Fig. 1) expected by 2011.

Observations on the flight deck and on the ground show that one in every three or four communications between pilots and controllers needs to be repeated or is misunderstood. All pilots and controllers exposed to CPDLC appreciate the benefits: fewer misunderstandings and reduced workload.

This leads logically to increased safety and efficiency, and provides extra capacity in the ATM system.

LINK 2000+ “simply” implements three basic services automating the routine tasks which fill up to 50% of controllers’ time today:

- ATC communications management: to handle repetitive frequency changes;
- ATC clearances: to provide standard clearances (e.g. “climb to flight level 350”);
- ATC microphone check: to enable communication in case of blocked frequencies.

These services do not replace voice as the primary means of communication – both media will always be available, thus providing mutual back-up, a definite safety improvement; in case of non-standard communications or
emergency, “revert to voice” is the procedure.

Before LINK 2000+, other programmes, such as the Dynamic Management of the European Airspace Network (DMEAN) Programme, will squeeze as much latent capacity out of the ATM network as possible without introducing technological change. However, traditional means of putting extra capacity into the system are for the short term and will soon be exhausted; new technology and tools like CPDLC are urgently needed.

CPDLC is also a prerequisite for further progress in implementing more advanced data-link services, since it provides key improvements in avionics and ground system infrastructure. The time saved by relieving pilots and controllers of routine tasks can be also used for new operational functions. After LINK 2000+, other programmes, such as CASCADE¹ and of course SESAR², will re-use and update LINK 2000+ services and infrastructure.

**From R&D to implementation**

The road from concept and R&D to implementation is long and hard in this industry. The whole process has taken more than ten years and has involved hundreds of people and many millions of euros. It is now essential to capitalise on this investment by implementing the Programme in a timely manner.

It is not possible to do justice to the effort of key individuals or describe all the projects and activities which have brought us this far; suffice it to say that all of the acronyms in Fig. 2 represent major pieces of work and will be recognised by many.

The ordered life-cycle implied in Fig. 2 is in fact a simplification of reality. A great deal of feedback has been required between the various life-cycle phases, and the lessons learned have been exchanged between stakeholders. A strict production-line or “waterfall” approach does not work in an environment where each step along the path is new.

**Concept and R&D**

The concept of the future air navigation system was published by ICAO in 1987 and was taken further forward in both the FAA and EUROCONTROL. The ground-breaking work of EUROCONTROL in ODIAC³ started in 1994 and resulted in the publication of the Operational Requirements Document (ORD), which provided the basis for much of the standards-related work taken on by ICAO.
Focus

Standards
The standards comprising the LINK 2000+ baseline combine the entire output of more than three ICAO panels specifying operational, technical and data-link standards over at least seven years (approximately 1990-1997). These were then used to define the interoperability, safety and performance requirements in EUROCAE* and RTCA* between 1999 and 2005.

Validation
The major projects validating the standards were executed by EUROCONTROL Headquarters, the Experimental Centre and industry. The funding for these activities came from the EUROCONTROL budget, with very significant amounts also being made available from the European Commission’s Fourth and Fifth Framework Research and Development Programmes. The activities spanned prototyping, laboratory testing, flight trials, and large-scale and real-time simulations. The results of the validation were fed back into the international standards bodies.

Operational proof and implementation
The LINK 2000+ Programme was created in 1999, following all of the activities summarised above and in Figs. 2 and 3.

The final key to kick-starting implementation and LINK 2000+ came from the creation and execution of the PETAL Project (Preliminary EUROCONTROL Test of Air/Ground Data Link). The PETAL Project grew from combining successful validation work in both the air traffic services and communication domains. For the first time, PETAL placed CPDLC services at the disposal of air traffic controllers and aircrew at one of the busiest en-route air traffic control centres in Europe. This constituted the final operational proof that CPDLC was fit for purpose.

Innovative implementation
The success of LINK 2000+ so far has been made possible by learning lessons and by taking an innovative approach between the traditional end of the validation phase and the traditional wait for mandatory carriage to happen. In order to break the so-called "chicken-and-egg" or "world-wide-wait" cycle, an unconventional three-step approach has been taken. (see Fig. 4)

The pioneer scheme: during this phase, airlines have been offered limited financial support to join the Programme early. The target of 100 aircraft has been exceeded, with 266 aircraft from eight airlines; this number is growing. The technical risk of joining early is removed, since all avionics are pre-tested by the LINK Test Facility at the EUROCONTROL Experimental Centre in Brétigny and by flight trials on an experimental aircraft. These activities are managed by the LINK Integration Team (LIT). All pioneers are members.

The incentives scheme plans to continue to increase airborne equipage during the period 2007-2011 in a similar manner to the pioneer scheme, so that early benefits are delivered to the air navigation service providers implementing LINK. LINK has worked jointly with experts from the Central Route Charges Office to define a scheme proposing some creative approaches to funding, which should be finalised by mid-2006.

Fig. 3 – A time-line to implementation

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Focus

Link 2000+
from R&D to implementation
Mandatory carriage is the final step. Incentives will be withdrawn two years before there is a legal obligation to equip. The proposed instrument to introduce mandatory implementation is a Single European Sky implementing rule. EUROCONTROL received the instruction to develop an implementing rule for data-link services from the European Commission in May 2005. It is currently under development in the Regulatory Unit and is due for delivery to the Commission by the end of 2006. Once agreed, the implementing rule will be legally binding and will apply to ground implementation by air navigation service providers and to aircraft operators.

The Link Integration Team (LIT) supports this implementation strategy. It is an innovation which was also a critical factor in the success of PETAL. The Integration Team consists of committed and contracted stakeholders outside EUROCONTROL’s standard working arrangements. The LINK Integration Team took over from the PETAL Integration Team and tackles all implementation issues; it is a one-stop shop solving aircraft-certification, interoperability, safety, technical and international-standards issues. Operational issues in LINK are dealt with by stakeholders in the Operational Focus Group (OFG).

What next?

2006 is an important year for LINK 2000+. We will move towards the end of the pioneer phase, finalise the financial-incentives scheme and see the outcome of the consultation process on the Single European Sky data-link implementing rule. (see Fig. 5)

Beyond LINK 2000+, we are planning to exploit the infrastructure and services deployed by LINK in the CASCADE Programme. Both LINK and CASCADE build towards the accelerated implementation promised by SESAR.

Conclusion

The demand for capacity in the European ATM network is increasing at record rates and is outstripping our ability to satisfy this need by traditional means such as re-sectorisation. New techniques and methods are needed, however, in order to continue to respond to this ever-increasing demand.

Saturated frequencies and reliance on voice communications between pilots and controllers represent a major bottleneck in the ATM network. Data link will help to relieve the congested frequencies and provide a safe and efficient second communications channel which will put extra capacity into the system.

The first package of data-link services designed for high-density airspace is ready for implementation; it will provide an essential part of the tool-kit needed to fill the capacity gap. Once it is there, the full potential of data link can be unlocked.
Time for change

The need for system support tools for air traffic controllers has never been greater. The forecast growth in air traffic, the drive for safety improvements, and cost efficiencies mean that the time is now right for a greater focus on the implementation of controller system support to meet the needs of the air space user. Classical methods of providing operational improvements all have their finite limits. New initiatives are necessary.

The fundamental tasks, roles, responsibilities and working methods of controllers have not changed in the last thirty years. The First ATC Support Tools Implementation (FASTI) Programme highlights the need for a coordinated implementation and rapid deployment of tools. The Programme will address short and medium-term requirements but will also enable the introduction of further automation in air traffic control in the longer term.

In today's area control centres (ACCs), controllers working in sectors are required to perform a number of key tasks, e.g. conflict detection, planning, traffic monitoring and coordination. FASTI aims to support controllers in these routine tasks through the implementation of:

- medium-term conflict detection (MTCD), which provides early notification of potential conflicts between flights;
- monitoring aids (MONA), which provide warnings and reminders on flights;
- system-supported coordination (SYSCO), which allows screen-to-screen coordination between ACCs.

The Programme advocates a move away from today's reactive way of working to a more proactive approach to ATC.

Today's limitations on the accuracy of flight data and surveillance mean that controllers are forced to take tactical decisions in a five to eight-minute window prior to a potential conflict between flights. Through the use of controller tools, the sector planning horizon will be extended up to twenty minutes with increased predictability and reduced uncertainty. As a consequence, decision-making will be improved and controller workload per aircraft reduced. This will lead to capacity, safety and cost-efficiency benefits.

R&D

The scope of FASTI originates from the fruitful and pioneering work undertaken in the former EATM Automated Support to ATS (ASA) Programme which sponsored the research and development of operational concepts, requirements and validation activities. Between 1997 and 2000, small-scale real-time simulations featuring MTCD, MONA and SYSCO were conducted at the EUROCONTROL Experimental Centre (EEC). Groups of controllers from over twenty States were involved in refining the concepts and operational procedures.

Between 2002 and 2005, on the basis of an increased level confidence and maturity of the tools, shadow-mode trials of MTCD and MONA involving live traffic took place at Malmö ACC, Rome ACC and Maastricht Upper Area Control Centre (UAC).

The first trial, held for three weeks with controllers from LFV at Malmö, used the EEC’s PROVE platform which enabled the capture of live flight-plan and radar data from the host system and permitted the evaluation of the tools in real time at EUROCONTROL controller working positions located in the operations room. Shadow-mode trials were conducted in Rome in partnership with ENAV during 2003. A major first was achieved when, during the trial, control of air traffic in the upper airspace over Milan took place from the PROVE platform with controllers using MTCD to plan separation.

In 2004, trials at Maastricht UAC gave controllers the opportunity to conduct shadow-mode trials in the Delta High and Luxembourg sectors. Results from this activity have been used to specify requirements for Maastricht’s new flight-data processing system.
The positive conclusion of the trials and the need to focus effort on speeding up implementation across Europe gave rise to the decision by EUROCONTROL Directors, supported by the ATM/CNS Consultancy Group (ACG), to launch FASTI in 2005.

FASTI is the newest member of a family of programmes within EUROCONTROL’s Directorate of ATM Programmes – Sector Productivity Business Division. Alongside LINK 2000+, Mode S/ACAS and CASCADE, it will provide operational improvements that will fill the gap between those short-term measures delivered by the Dynamic Management of the European Airspace Network (DMEAN) and the start of more long-term changes expected from SESAR. Its process of moving these activities from research into implementation is ongoing at national level, with deployment expected from 2007 onwards. The recognition by FASTI of the value of this work and its potential re-use by the wider European ATM community, in the context of implementation, has been an important aspect in the setting-up of the Programme.

While replacing complete ATC systems, a number of service providers particularly in Scandinavia and the Balkan regions, have already implemented some FASTI capability. These pioneers have learnt valuable lessons from initial operations which are now being taken into account within the Programme.
There are basically four main reasons why the European Commission does research into air traffic management. The first is that air traffic management (ATM) has in the past been too much a collection of national initiatives whereas a stronger European level focus is needed, reflecting the fact that air transport in Europe is essentially an international activity. Secondly, one of the objectives of the European Commission framework programmes is to support the competitiveness of European industry. The third reason is to support policy making as the Directorate General for Transport and Energy has the responsibility for ensuring that the air transport market functions efficiently and effectively. Fourthly, we believe the current approach to ATM will be unable to provide the level of service required for the future in terms of capacity, safety, efficiency and cost-effectiveness. Consequently, our research is focussing on the future solutions.

The European Commission (EC) started getting involved in ATM research in 1992. At that time, the EC contribution was very small, with the vast majority of the research being carried out in the Member States, often with a significant amount of duplication – nobody accepted anyone else’s results or even ideas. Since that time there has been a radical restructuring of ATM research with currently some 80% of all R&D (Source – ARDEP) in ATM being driven by EC and EUROCONTROL funding.

The feature of EC funding that gives us an influence beyond the amount of money we provide is that projects have to be multinational by definition and our contribution is usually only 50% of the total cost, the other 50% being provided by the participants (typically manufacturing industry, air navigation service providers, research agencies, etc.).

Such partial funding has advantages and constraints: the advantages are that the R&D must be needed – otherwise the industry would not invest; as projects are multinational and ‘risk-sharing’, partners must be able to work with, and have confidence in, their fellow consortium members; IPR† is owned by the consortium, rather than the Commission, and exploitation of the results by industry is easier. The downside is that we cannot ‘force’ the consortium to go down a route they do not like, although it is true to say that we can usually ‘persuade’ them; contract negotiation is a bit more complicated because it has to find a mutually acceptable balance between European needs and national or industrial interests – sometimes this balancing is hard, sometimes it isn’t.

Since the beginning, cooperation between the European Commission and EUROCONTROL has been significant, both with Headquarters and the Experimental Centre. This cooperation has taken several forms, with Headquarters providing technical advice and support to the Commission, funding complementary work on EC funded projects, and providing funding to the Centre to help their participation in EU projects. It is true to say the role of the Experimental Centre in EC research has been substantial.

1- Intellectual Property Right
1998), the Centre participated in a number of projects ‘free of charge’ – effectively being added to the project by the Commission during the contract negotiation phase. The most significant example of this was the AVENUE project, which developed the concept of ‘Avenue Compliance’ to facilitate ‘plug and play’ in ATM simulators. This project led to the development of the ERIS programme and the Avenue-Compliant Escape platform (ACE), which has subsequently been ‘spun out’ to a number of European air navigation service providers.

In the 5th Framework Programme (1998-2002), the participation of the Centre changed significantly, with it becoming a full partner in the consortium before the submission stage and hence receiving funding from the Commission. A significant example of this is the main ATM R&D project (Gate-to-Gate), in which EUROCONTROL is the biggest individual partner, accounting for nearly 25% of the total effort. This tendency towards greater involvement developed even further in the 6th Framework Programme (2002-2006) in which EUROCONTROL is actually leading a number of projects, the main one being the large concept validation task (Episode 3) in support of SESAR, but also in innovation such as the Erasmus project.

To reinforce the synergy between EC and EUROCONTROL-funded research and to maximise the influence we jointly have on the ATM research being carried out in Europe, the two organisations have set up the Joint Programme Board to develop a common research strategy, to align projects and programmes and prioritise R&D funding. This Board meets on a regular basis and comprises Directors from Headquarters and the Centre, and both DG TREN (Energy and Transport) and DG RTD (Research and Development).

Clearly the most significant initiative at European level to develop the future ATM system is the SESAR programme, and it will be the guide and federator for all future R&D in Europe for many years to come. The Definition Phase of SESAR is jointly funded by the Commission and EUROCONTROL on an equal basis, the Commission through cash from the Trans-European Networks programme (rather than from R&D budgets), and EUROCONTROL through cash and in-kind contributions. The Definition Phase, as its name suggests, will define what future system needs to be developed and how. This will be followed by a Development Phase, which is intended to be jointly funded on an equal basis by the Commission, EUROCONTROL and the aviation industry (in its broad sense). The development phase is expected to be funded at the level of €300 million per annum from 2007 to 2013. It is expected that SESAR will continue beyond 2013, but this is currently the limit of our financial perspectives.

Proposals for the establishment of a governance structure for the Development Phase are currently being discussed in the Council of the European Community and the European Parliament, and it is hoped that agreement will be reached towards the end of 2006/early 2007. The governance structure being proposed is a Joint Undertaking (along the lines of what was set up for Galileo), which will comprise the Commission, EUROCONTROL and industry. It will manage the development phase and the R&D contracts that will flow from that. The Joint Undertaking will also be open to a cost-sharing participation by non-EU Member States.

SESAR is clearly the guiding light for all future R&D in Europe and it is expected all R&D resources will be mobilised to make it a success. This investment in the research and development tasks will be complemented by the legislative and enforcement powers of the Single European Sky legislation, and support to implementation through the Trans-European Networks programme.

“Some 80% of all R&D in ATM is currently being driven by EC and EUROCONTROL funding”
Future concepts for the air transport industry target changes in both pilot and controller roles with the prospect of a strategically managed rather than tactical system. How do you interpret and envisage this change of roles for the controller, for example the controller as a “manager”? Certainly, the notion of controllers assuming some form of management role is not new. Nevertheless, the real question is when this transition is likely to occur, and more importantly what will it be like? By transition I mean the move from the current model of air traffic control to the new one.

Today, we see controllers operating as “managers” of flows as well as tactically controlling the traffic within the flows. Although we might not be totally aware of this, this is the way we control traffic, and it is probably nothing new to controllers.

The evolution of a controller to operate as a manager assumes that the control process is distributed or transferred elsewhere in the air traffic management system. So, the human actor will be distanced from the actual tactical activity – the separation of the aircraft. Such a modus operandi may be acceptable if the system has the mechanisms and processes in place that allow control to be maintained in the event of emergencies or system disturbances. For the time being it is difficult to envisage how a strategically managed system over dense continental airspace can have any manual “reversion” for the controller on the ground to address the situation, if required.

However, this situation is a long way away in our view, and it is the implementation of such an operating philosophy which is probably the greater cause for concern. For example, Free Flight Airspace (FFAS) as envisaged in the current operations concept presumes a dynamic volume of airspace. There needs to be an interface – a transition zone from FFAS to managed airspace (MAS), and this has been shown to be problematical. No problem is insurmountable.

There seems to be a conceptual trend towards integration of the pilot in the separation management task of the controller, initially through such concepts as ASAS spacing, but perhaps later with pilots taking responsibility for self-separation. Do you see this as bringing benefits to the system? What impact will it have on the workload for the pilot?

IFATCA is aware of the work for the development of Airborne Separation Assurance Systems (ASAS). We are participating with EUROCONTROL and the European Commission in initiatives such as the ASAS-Thematic Network and CASCADE.

We, like others, find the terminology misleading. ASAS package I applications embrace a multitude of ground and airborne uses. The ground-based surveillance applications – which some of our members are using in operational trials around the world – offer substantial safety and capacity benefits in some operational environments, but not necessarily all.

Airborne surveillance and separation applications do cause concern amongst the controller community. There is a mountain of reports and documentation that shows that it is a viable...
option. The Co-Space, MFF® and NUP® experiments, for example, demonstrate the viability of various concepts, and the nature of some of the problems in implementation as well as the scale of the potential benefits. We are concerned about how airborne traffic situational awareness applications will affect flight-deck controller interaction.

ASAS is not, in our view, a stand-alone system at the Package I and II level, but one of a battery of control techniques that will be deployed in the ATM system. It will therefore need to be integrated with other ATM system components. Herein lies another of our concerns. The potential benefits to the ATM system as a whole might be smaller than those from alternative control techniques. In our view, it is not a debate between one and the other but about how the two are fused together into an integrated control philosophy that delivers the capacity and flexibility which the airspace users desire. The trade-offs are not well enough understood, in our view, as the industry becomes entrenched in polarised views.

The work of the safety data reporting & data flow (SAFREP) task force has shown that there is a need to go beyond the aviation circle with regard to the explanation of what is needed from a safety point of view, when it comes to the just reporting culture in aviation.

In IFATCA we do not want blame-free reporting, but we insist on the fact that a just culture is essential for the future of the aviation system. There is, however, a problem with regard to measuring safety as highlighted in the PRR8 report. Safety must be measured only in order to enhance safety and should not be used to benchmark one air navigation service provider/State against another. This notion is still not well understood by the decision-makers. If safety indicators were to be used to benchmark the performance of a single air navigation service provider/State, this would destroy all the benefits of safety reporting in terms of improving safety. One has to admit that much research has already been done, and some of the civil aviation safety record is due to three key factors: dedication to safety, a continuous learning process (i.e. exchanging safety information), and the ability to learn from errors. A lot of information has already been collected.

The question our members are confronted with, however, is what to do with this data in order to develop an understanding of the real safety issues and consequently develop strategies to improve safety. What our members experience is rather the contrary. The trend has been to use safety information for disciplinary/enforcement purposes, and as demonstrated by court cases, this sometimes ends in criminal charges against controllers. IFATCA and ICAO have for some time been urging

“ A just culture is essential for the future of the aviation system”

Turning more specifically to safety, the 8th Performance Review Report (PRR8) states that the quality, quantity and consistency of ATM safety information are inadequate for measuring and managing safety at European level, and that the way forward must include enhanced legal protection to reporting individuals. How do you see the legal framework evolving within the SESAR implementation timeframe, and what is the role of research?
Marc Baumgartner, President and CEO of IFATCA, sheds light on the air traffic controllers’ perspective on the changing ATM environment.

I would just like to highlight a few: many service providers used to be government bodies but it became clear that governments could not effectively or efficiently operate air traffic control services in a changing world. Many felt that government procedures hindered the decision-making processes, leading to inefficiency. Although many ATC associations were involved with the change-over processes, after a year or two of commercialisation/privatisation the “shine” wore off and there was less cooperation from controllers.

Before long the “business mentality” reared its ugly head and it became clear that personnel costs were too high and that productivity had to increase. Hiring and training has been stopped in order to cut costs. The shortage of air traffic controllers is continuing to produce lots of delays – despite the air navigation service providers’ favourite solution, which is outsourcing to reduce costs. There have been calls to increase training or to make controllers work overtime. This trend away from investment in the longer term has had serious system safety implications. Our members are experiencing increasingly strained relations between management and staff representatives. This has led, or will ultimately lead, to more delays, greater costs for customers and a direct impact on safety. The role of the regulator has changed and this has not been identified sufficiently early enough. This has led to a lack of resources (both financially and in qualified personnel) at the regulatory level – which in some cases has led to a complete breakdown of safety and economical oversight of the system rather than a change in the situation. It is essential from the outset to appreciate where the controller is in the system. Controllers are system users just as much as other stakeholders. As such, they have requirements from the system to enable them to perform their role and responsibilities, even if these themselves are changing. All too often, these requirements are misunderstood or ill-defined, and the design of any solution is lacking in some major way. It is sometimes said that the controller is a major obstacle to progress in ATM. Research needs the partnership of the controller community first to create the collective vision and secondly to develop and validate the concepts and systems. At the same time, it is normal and necessary that the controller opts for a stable system rather than a changing system in order to ensure safety. How can the controller reconcile these conflicting roles and how can the researchers help?

“One way to ensure that controllers are prepared (for future changes) is to engage with them in their natural language and understand their perspective”

This is a very perceptive question, and the answer is not simple.

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In this connection it is essential that controller needs be understood. Controllers

States/providers to examine/adjust their laws and regulations to protect operators against this practice. There are very tight provisions protecting some accident/incident records in judicial proceedings. We want the same protection for information from safety data collection systems. This is proving very difficult to obtain and only a few States around the globe have legislation protecting this type of information. Getting it may not be possible owing to incompatibilities with their judicial systems. This must change! We therefore call upon the States in Europe and around the world to re-examine their respective legal systems. States must recognise that the purpose of the law is to maintain or increase safety for their citizens and that laws cannot achieve this if they contain only punitive provisions to prosecute failure. To maintain or increase safety, the law must balance punitive provisions against the need to protect reporting and recording of safety-critical events so that corrections can be made to the system to prevent future system failures. In view of the projected increase in traffic, it is essential for States to protect safety data collection in order to at least maintain existing safety levels.

**Controllers have expressed concerns about the gradual corporatisation and privatisation of service providers. Is this a real concern and in what areas?**

The corporatisation/privatisation of air navigation service providers represents a major change in the working relationship between controllers and the employer. It is a new world for us and we have many concerns. In IFATCA we have a list of items which we urge our members to look at carefully when faced with this new trend.

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are concerned about safety, because safety is at the heart of what they do. Nevertheless, this is often misconstrued as a barrier for change. Safety and the mitigation of risks are areas that require more research; particularly the human performance requirements of real-time problem identification and solution.

What is perceived as a simple change, with no major impact on the controller's task or modus operandi, frequently has effects contrary to expectations. Examples abound. Controllers are therefore renowned for mistrust of those planning the future. The way forward must be to build this trust and engage with the controller population in positive and meaningful ways.

Consequently, if the research community is prepared to consider us as professionals with the ability to add value to ATM research and outcomes, then it will be easy for controllers to become committed to engaging positively to developing the future system.

This is a commitment that controllers are prepared to make, but only if there is genuine acceptance of a meaningful role for the human operator. One must be mindful too, that we have a duty of care, a responsibility towards those who will be operating the systems we are researching today. Many of these controllers have yet to be recruited or even born.

**SESAR is now a significant focus for many in the air transport industry, what are your hopes and expectations for this initiative?**

Like any other recent pan-European initiatives aimed at fostering implementation of a harmonisation plan, there is a danger of focusing first on institutional issues, only later to realise that technological reality is far from the political objectives. In the end, it will be the customers who will realise that the new system costs much more than the current one. To be fair to the current process, one has to agree that it is most probably the first time that such a large buy-in from industry and Member States has been achieved.

The fact that the management of the process is given to Air Traffic Alliance (ATA) is certainly positive, putting the logistics in place for a successful management of the process for the definition phase. Currently, we at IFATCA have difficulty understanding what will happen after the definition phase – the current plans do not stretch further than 2012. In aviation, it normally takes at least seven years to make things happen. A major stumbling block identified is that the project is already experiencing delays in the delivery of the final product for the definition phase. This can be attributed to a number of factors: the institutional instability which is currently prevailing within the Single European Sky, the need to meet differing objectives, the fact that some of the work packages have the inherent goal of competition, and that the whole initiative will not have sufficient funds available.

**Finally, how should we focus our research in order to facilitate the transition towards the new controller role?**

Transition per se is, to controllers, a major area of concern. It has been in the past, it is today, and it will be in the future.

If we are to leave the human in control, then the transition needs to show that it understands what the human needs are in order to satisfactorily and safely move to new systems. So often, this area is neglected. The perceived magnitude of the changes to come make this area a pre-requisite for success.

There are several areas that to date have been elusive in research terms. One of these is the role of the human and system and what is needed for them to co-exist effectively. We have so much more work to do to develop a sound philosophy to work towards the future.

At some stage, the research agenda must simply move from the rarefied and near-perfect research environment to the not-so-perfect and stochastic real world. Controllers will always relate new concepts back to the real-world problems. One way to ensure that controllers are prepared is to meet this directly and engage with them in their natural language and understand their perspective of the domain.
Aviation is an essential contributor to Europe’s economic prosperity and the outlook for commercial aviation growth remains strong in spite of global economic difficulties. The liberalisation and deregulation of the airline industry have significantly contributed to such growth. In future, more and more people are expected to be travelling and more planes will be taking to the skies. This means that if no additional measures are taken, the European air traffic management (ATM) system will be heading for gridlock. It is therefore time to set the current ATM system on a course for the transition to new and more cost-effective operational scenarios and technologies.

Against such a background, European States and air navigation service providers constantly need to develop their CNS infrastructure and ATM services in order to meet future air traffic growth safely and efficiently. Currently, air navigation services and the systems that support them are not sufficiently integrated and are based on technologies which are already running at maximum. In order to accommodate future air traffic needs, the aviation community must rethink the current European ATM system by implementing a paradigm shift, supported by innovative concepts and technologies.

As one of the key Mediterranean air navigation service providers, ENAV has always shown a strong commitment to air traffic management innovation. ENAV has in fact been leading a large number of complex studies and validation activities with the aim of defining a detailed implementation plan for new ATM services in the Mediterranean area. Over the years, ENAV has also been supportive of EUROCONTROL and European Commission R&D initiatives and projects. In line with this approach, ENAV is also fully committed to and deeply involved in SESAR – the Single European Sky Implementation Programme – in which the industry is going to jointly define, commit to and carry out a pan-European CNS/ATM implementation programme.

In the current European scenario, we think that SESAR is the catalyst that will bring all the aviation elements and actors together with a view to eliminating the current fragmented approach to ATM – it will transform the European ATM system, synchronise the operational concepts, plans, actions and resources of the various partners and federate all the actors, including industry. We believe it is time to move all together towards CNS/ATM R&D and the implementation of validation results. This will deliver operational benefits and provide the users with immediate improvements in terms of efficiency and capacity.

Innovation is one of our greatest challenges. Central to innovation is the acknowledgement of the need for a common vision of the future ATM system. Such a system will not be achieved by simply acquiring new CNS technologies. Key factors in the enhancement of the current system’s performance will be regional ATM R&D and validation cooperation, and civil/military cooperation.
In essence, R&D and associated validation activities should be mechanisms to bring together all interested stakeholders to develop a pragmatic long-term vision, create a coherent, dynamic strategy to achieve that vision and steer its implementation.

In this context, regional cooperation on ATM R&D and validation activities should allow for faster and more cost-effective implementation of new ATM operational concepts and sustain European ATM harmonisation and integration. The underlying rationale is that the Single European Sky initiative is not expected to be implemented at the same time and at same speed across Europe, owing to the fact that economical, technical, operational and institutional contexts vary from one region to another. Therefore, a regional approach would be a more efficient strategy towards the convergence of operational concepts and systems implementation for Europe as a whole. This regional approach should not be limited only to the European Civil Aviation Conference (ECAC) area but should also include the States at the periphery of ECAC that are interested in being involved in the European Commission’s and EUROCONTROL’s initiatives. With this in mind, ENAV has already signed several partnership agreements with other air navigation service providers in the Mediterranean area with a view to establishing a formal framework for R&D cooperation.

Another important element for successfully building a new ATM system for the third millennium is looking at places where we can introduce changes incrementally. In future R&D and validation activities, we are expected to take a building-block approach towards fielding new operational concepts and systems in order to provide benefits to users as soon as possible. At the same time, a building-block approach brings user benefits and will show stakeholders that we know where we are going and how we are going to get there. Part of what has in the past stymied the evolution of the current ATM system has been going after too grand a vision and losing sight of the achievable, making “perfection the enemy of the possible”.

We all know today that there are several major risks associated with CNS/ATM implementation programmes. These risks include avionics costs, validation, certification procedures, human factors and user acceptance. The massive changes and experiences gained over the last few years in terms of air traffic growth, new technologies, programmes management and the definition of operational procedures have highlighted the basis for an evolution of the ATM system in which the human is the key element.

In this framework, the role of R&D and pre-operational validation activities will be crucial for the achievement of results in terms of ATM system evolution to face the increasing demand in the air transport market accelerated by air transport liberalisation and market globalisation.

European R&D centres have the knowledge and expertise required to provide the necessary validation framework to assess the “fitness for purpose” of the future ATM system defined by SESAR. It is absolutely vital that in years to come R&D should become more effective by making better use of its distributed expertise and facilities. This should be the focus of the attention and the work of the entire R&D aviation community; the final objective being to ensure a safe, secure and efficient ATM system capable of supporting future traffic growth.
Firstly, there is a need to prove quantitatively that a development will be beneficial before investing large amounts of money in R&D. The means required for such an analysis are, however, far from being fully available. The difficulty of developing these means must not be underestimated, primarily because the analysis must be holistic and precise enough to identify multiple impacts across the board. In this way, the double-counting of benefits can be avoided and the rationale behind the results can be clearly seen.

Some instances of successful R&D projects could, however, be cited by way of examples of R&D effectiveness. I could mention LEONARDO, G2G and C-ATM, all of which were financed by the European Commission with EUROCONTROL as a key partner. There are also a number of future projects, such as Episode III or RESET, for which we have high expectations.

The next question is what should be considered a success in the R&D arena: looking for clear indicators of R&D success and effectiveness is another challenge. There are essentially two sources of failure in R&D. Firstly, there may be a development failure (this is the most widely known source of failure but would not appear to be the main one); secondly, we may be faced with a given technology that is not used at all, or used late. This is because a technology's global benefits need to be demonstrated for stakeholders to implement it – otherwise it will be implemented only when it becomes mandatory.

Another option, however, would be to gather arguments in support of the benefits of a planned approach to R&D. In this connection, one cannot fail to mention developments such as the integrated working platform for the optimal use of analytical techniques (PITOT), with its promise of hybrid simulation, and the initiative to define a fully comprehensive validation infrastructure across Europe.

Another approach would be to look for inefficiencies resulting from the fact that the theoretical role of each potential actor in the R&D chain is not fully respected: laboratories for innovative research, service providers in defining operational needs and specifying services, and the industry in developing the specified products.

Many ideas and approaches could be used to gauge the effectiveness of R&D.

The following headline from the Spanish newspaper El País provides some inspiration: "Crisis of faith in R&D". The article starts with these words: "the search for innovation was, for a long time, a matter of faith; if you invest more, profits will follow". Examining the article’s sources for further information, I found an interesting report entitled "The Booz Allen Hamilton Global Innovation 1000: Money Isn’t Everything". Here, in the points below, I make a number of comments on this and other related sources:

- From a financial viewpoint, R&D is merely a means for increasing the sustained profitability of a company. It should not be seen as an objective in itself.
- If you are small, it is better to look for economies of scale through work in partnership. This is the case for ATM R&D teams: we need to cooperate and agree on concepts and technologies. Sharing experiences and expertise is the cheapest path to the future.
- Timing is a problem. Results are always needed yesterday. R&D, however, is a search, and hypotheses may change along the way. Traceability is therefore needed, from requirements and hypotheses to performance and results. If the reasons leading to a specific development undertaking are known, the path may be altered when changes in the surrounding conditions dictate.
There is a need for sustained effort. Continuity is the key.

Money does not buy results (sometimes, indeed, the contrary is true), but scarce resources equal failure. Simply investing more will not solve the problem (though further investment is nevertheless required), as proved by a number of exercises in the past (MLS). The problem is also methodological (R&D procedures are a key factor for success).

Just as important as technical success in R&D is doing the right research – the research which is required by the market and which you will be able to implement later on. This is a paraphrase of my opening statement: there is a need to prove the benefits and feasibility of implementation before development can begin.

There are methodologies even in the field of inventiveness (e.g., the TRIZ method); but creativity is also relevant. Looking for ideas means recognising that there are other clever people out there (and here I am referring to aeronautics) and according the appropriate importance to exploratory research.

Merely waiting for the future to arrive (i.e., satellite solutions) is not the right approach either.

Identifying R&D success factors on the basis of statistical data from surveys (“what do you consider important?”) is normal practice. Should the same approach be used in order to establish which points are to be considered in relation to R&D analysis? Agreement is needed in ATM, but is it the solution? Having agreement does not mean being right.

To sum up: “[…] an innovation edge will need to rely less on faith and more on creativity, analysis and disciplined management”.

Even when all these aspects are carefully considered, however, putting them into practice does not automatically guarantee R&D success, because of the nature of the ATM business. Development and implementation cycles for aeronautics are long enough to discourage adventurous investors. If investments are not in place within four or five years, what happens? Nothing happens immediately, as the lack of R&D investment only becomes apparent in the long term.

In any case, the business is such that you can obtain the right support only if you prove that a development is good (in quantified terms) and that it will work. The problem is that “proving” in this case means neither simply giving opinions based on broad experience nor simply showing that the development works (which also requires the technology to be developed beforehand, a rather expensive approach).

On the other hand, one could simply define the technology or concept up to a level allowing the identification of what would be its ideal performance if everything went well in terms of the development process and if every problem was solved, and then quantify the impact on the global ATM system (taking special care not to double-count benefits).

Of course, when one comes from the conceptual world of the R&D domain, “ideal performance” is not that astonishing an idea – but in any case there is always a theoretical maximum ceiling that can be used. Sometimes even if we take the best possible figures, the system’s performance is still not good, so why continue investing? Elaborating this idea a little further, one could even determine the performance make-or-break point for the technology under analysis, i.e., the minimum performance required in order for such a technology to be beneficial. In addition, element-combinations analysis will reveal the appropriate road map and will help to prioritise investments.

Validation platforms for taking the approach described previously are not available today and would appear difficult to develop. We should therefore continue to listen to expert opinions and develop without full knowledge of the development’s relevance (but not just basing it on a wild guess either). There is no alternative – or is there?

The answer is that there is, in fact, an alternative: to develop the required validation infrastructure. We do not need to wait for this to be available in order to start the remaining R&D activities (since these have been running for decades without any such support). The fact is that we cannot afford to wait any longer if we want to avoid wasting already scarce resources, or if we want to see the technology implemented in the real world.

Going back to my introductory statement, there is a “need to prove (quantitatively) that a development will be beneficial before investing large amounts of money in R&D”, as a way of avoiding overspending.

So, what is the “Holy Grail” for R&D? Is it the idea proposed in the previous paragraph? Unfortunately, I am only guessing that it is, and have not proved it. Would you like to buy into it?
New Air Traffic Control System operational in Lithuania

The Lithuanian Minister of Transport and Communications, Mr Petras Cesna, officially inaugurated the new Lithuanian air traffic management system, supplied by Thales, at a ceremony on 30 November 2005 in Vilnius, Lithuania.

French Ambassador Mr Guy Yelda, the Director of the General Secretariat of EUROCONTROL, Dr Gerhard Stadler, and the General Director of the Lithuanian air navigation service provider Oro Navigacija, Mr Algimantas Rascius, were among the officials who attended the ceremony.

With a view to modernising the Vilnius area and aerodrome control centres, the Lithuanian ATC Centre Modernisation Programme (LACMO), launched in 2002, provides the air navigation service provider with increased capacity to meet the forecast traffic growth and provides airlines with advanced services.

The new Lithuanian Eurocat X air traffic management system meets European standards and the latest operational requirements for air traffic control. The system supplies automatic flight and radar data processing, combined with flight monitoring aids and safety facilities, such as short-term conflict alert, minimum safe altitude warning and restricted area warning.

“This ceremony marks an important success, both for the LACMO programme and the modernisation of the Lithuanian air traffic management system, contributing to the implementation of the Single European Sky and EUROCONTROL requirements,” Mr Rascius said. “Close and fruitful cooperation between Oro Navigacija and Thales enabled the programme to be completed one month ahead of schedule.”

The accession of Lithuania to NATO and the European Union and sustainable economic growth have been the drivers increasing demand for travel to/from other European countries. The growth in GDP in Lithuania will remain high in 2006 compared to other EU Member States. Exports and imports continue to grow and the flow of direct foreign investment is increasing. At the same time, the successful economic development of Lithuania has not been affected by rising oil prices and economic stagnation in Western Europe.

There has been a constant upward trend in air traffic growth over the last few years. 2003 saw a 10.29% growth on 2002, 2004 saw a 25.42% increase on 2003 and in 2005 there was a 12.22% traffic growth compared to 2004.
Skyway 40 - Spring 2006

Vilnius international airport handles 70% of Lithuania’s airport traffic, with 1,105,594 passengers in the first ten months of 2005, which represents an increase of 31% on the same period last year.

Thales is playing an important role in the programme to modernise air traffic services in Lithuania by supplying the full range of ATM products – control centres, radars, a simulator and nav aids, including the ILS 420, the most technically advanced instrument landing system.

The Vilnius ATC Modernisation Programme has contributed to the development of the air traffic control system in Lithuania, preparing it to meet the future challenges in terms of safety and passenger capacity.

The next step in the programme will be the procurement of several new landing and navigation systems for the airports in Vilnius and Palanga. During 2006, two ILS 420 systems, a DVOR 432 system and an NDB 436 system will also be installed in Vilnius and an NDB 436 system in Palanga.

LACMO – the Lithuanian ATC Centre Modernisation Programme

In 2002, the Lithuania air navigation service provider launched a modernisation programme for the complete upgrade of the Vilnius ATC Centre system.

The User Requirement Document (URD) and the Functional and Technical Requirement (FTRD) documents were prepared taking into consideration EUROCONTROL requirements. Appropriate feasibility studies were also conducted. Two main new aspects, such as revision of the concepts based on the service provider’s Development Strategy to ensure compliance with the overall CNS/ATM System Architecture, and guidance on the conduct of feasibility studies were incorporated into the development process.

Vilnius air traffic controllers were involved in all stages of the process.

The contract for the Lithuanian ATC Centre Modernisation (LACMO) was signed on 26 November 2003. The simulator has been operational since 12 July 2004. The Factory Acceptance Test (FAT) was successfully completed on 18 November 2004. The system was inaugurated at the end of November 2005 and became operational in December 2005.

Lithuania is once again at the cutting edge of ATM technology. The LACMO programme at Vilnius comprises a wide range of the latest Thales systems. The installations include a EUROCAT centre with 5 operator positions and a simulator. The EUROCAT centre uses the highly adaptable Thales ATM benchmark equipment. It can handle multiple situations from approach to en-route control in a variety of geographical environments, traffic densities and operational situations. The EUROCAT simulator is used for controller training, procedure evaluation and software upgrade testing.

For Vilnius International Airport, the system has been adapted further to include automatic flight and radar data processing, combined with flight monitoring aids and safety facilities such as short-term conflict alert, minimum safe altitude warning and restricted area warnings.

Civil aviation policy in Lithuania

is the responsibility of the Ministry of Transport and Communications. The Lithuanian Civil Aviation Administration (CAA) is the National Supervisory Authority. Oro Navigacija (ON) is a State enterprise; it is the sole air navigation service provider in Lithuania; ON is an independent State-owned enterprise, which operates under the supervision of the Ministry of Transport and Communications, completely separated from the regulatory authority.
GNSS Introduction in the Aviation Sector

The GIANT Project

Project objectives

The GNSS* Introduction in the Aviation Sector Project, known as GIANT, is the response of an international consortium, led by INECO, to the European Commission (EC) 6th Framework Programme (FP6) Call 2411, Area 1A, for the GNSS Introduction in the Aviation Sector. This Call is managed by the Galileo Joint Undertaking (GJU), with the support of EUROCONTROL. This Project is aimed at supporting the introduction of EGNOS and Galileo services in the aviation sector, maintaining the required safety levels. It is essential that this project is based on the results of EUROCONTROL activities. Consequently, it is closely coordinated with EUROCONTROL, which supports the GJU and performs the technical management of GIANT, ensuring that the project directly supports and provides added value to the existing navigation domain activities.

The Project began on 12 July 2005 and will last two years.

The GIANT consortium

GIANT is a user-driven project, meaning that it deals with the development of a solution proposed by the industry, promoted by the air navigation service providers and accepted by the users (airlines and helicopter operators).

Consortium and experts’ skills cover all required technical competencies for the successful completion of the Project entrusted to the GIANT consortium (See Figure 1):

- EGNOS service provider: ESSP;
- airspace users: Air Nostrum, REGA;
- industries:
  - aircraft and helicopter manufacturers: Bombardier, Eurocopter;
  - receiver manufacturers: Septentrio, CMC Electronics Inc.;
  - local elements manufacturers: Thales ATM, Terma;
  - avionics systems integrators: Rockwell Collins;
- consultancy companies: INECO, Helios, FDC, Advantage, Avtech, Isdefe, Pildo Labs;
- universities: International Institute of Air and Space Law (University of Leiden).

Since GIANT aims to increase awareness among airspace users, aircraft and avionics manufacturers, it has concentrated the flight demonstration campaign on the regional and rotorcraft market, probably the airspace users most interested in introducing approaches with vertical guidance (APVs) based on EGNOS. The consortium comprises a complete value chain from the manufacturer to the actual end user (for both aircraft and rotorcraft).

Project work breakdown

The work has been organised into eight different Work Packages (WPs) that interact among themselves in order to ensure that the Project objectives are fulfilled.

WP 1 – Action and transition plans

The purpose of the work package is to provide an exhaustive and comprehensive assessment of all the already-identified EGNOS/Galileo applications in comparison with the various technical and non-technical enablers and to propose specific action plans in order to build a...
strategic plan for the progressive introduction of GNSS services in aviation, complementing the tasks to be developed by EUROCONTROL. A specific transition plan from the EGNOS to EGNOS/Galileo context will be proposed.

WP 2 – Development of innovative applications
This WP will identify innovative non-navigation applications and services that could be supported by GNSS.

WP 3 – Demonstration of the operational benefits of GNSS to airspace users
This WP will provide the appropriate instruments to increase the mutual awareness of the aviation and GNSS communities so as to promote the introduction of GNSS in the aviation sector and investment in GNSS (mainly oriented towards aircraft manufacturers and airlines). Various operational scenarios (including flight trial campaigns in a real operational scenario based on EGNOS) have been proposed to simulate future EGNOS operations.

WP 4 – Business, market, financial and safety studies.
This WP will undertake safety and financial studies to support the awareness-raising campaign. It will demonstrate the potential benefits of EGNOS/Galileo services and investigate safety aspects.

WP 5 – User terminal
This WP will define the airborne system that is required to take advantage of the services provided by EGNOS and Galileo, taking into account that the airborne architecture will be different for the different categories of airspace users such as general aviation and transport category aircraft.

WP 6 – Local elements
This part of the Project addresses the service enablers, open issues and main risks linked to the introduction of the applications supported by the future local elements of Galileo, GBAS® type, installed at airports in order to provide a precision approach and landing capability.

WP 7 – Assessment of legal and regulatory GNSS enablers
The regulatory activity will comprise an in-depth assessment of the current frameworks and consider proposals made so far before formulating a recommended policy which can be used to overcome any identified obstacles, either by a legal work-around or a new legislative approach.

Flight trials campaign
It is worth mentioning the flight trial and test campaign that will be carried out within the framework of the GIANT Project. Its purpose is to demonstrate to the aeronautical community the benefits of the services provided by EGNOS/Galileo. Consequently, and after an initial analysis phase, a couple of potential operational scenarios have been identified in which the users can obtain major benefits from the use of GNSS systems.

Scenario 1 – Aircraft
This scenario aims to demonstrate the estimated benefits of GNSS through a number of APV approaches based on EGNOS at the non-ILS®-equipped runway of Valencia airport. Additional flight trials will be performed in other European airports. The trials will be performed by the major Spanish regional airline, Air Nostrum, using Dash-8 aircraft (Figure 3). The key added value for these trials is that, for the first time in Europe, the flights will be conducted by a regional airline plane using the available EGNOS signal.
Scenario 2 – Helicopters

This scenario aims to perform a local demonstration of EGNOS capabilities for improving the safety and reliability of HEMS operations. Indeed, almost all HEMS flights today are still conducted under visual flight rules (VFR), even at night and in adverse weather. Firstly, some pre-demonstration flights will take place near Eurocopter installations in Marignane (France). Secondly, two major trials will be performed consisting of IFR APV approaches based on EGNOS in a heli-pad in Lausanne and low level IFR flights linking two Swiss hospitals. The Eurocopter EC155 Systems Demonstrator helicopter (Figure 4), the Eurocopter flying platform for advanced systems research, will be used. Pilots from Sécurité Civile (French Search & Rescue service), REGA (main Swiss HEMS operator) and FOCA (Swiss Civil Aviation Authority) will be invited to participate onboard the EC155 in performing some approaches.

Additional flight trials

Additional flight trails are being proposed for both the aircraft and rotorcraft scenarios. The former would consist of APV approaches with integrated SBAS* avionics on CRJ 200 aircraft operated by Air Nostrum (Figure 5). The helicopter scenario would cover EGNOS-based approaches to oil rigs in the North Sea which are characterised by severe meteorological conditions and a structurally complex environment.

Additional information and reporting of results

Within the scope of the GIANT Project, two user fora are foreseen in order to create awareness and to report on the results. The first one is planned for the end of June 2006, alongside the flight trials in Valencia (Spain), and the second one by the end of the Project (June 2007) at the EUROCONTROL Headquarters in Brussels.

Further information can be found at www.gnss-giant.com.
Global Aeronautical Information Service Congress

A Global Aeronautical Information Service (AIS) Congress will be held on 27-29 June 2006 in the “Palacio de Congresos” in Madrid, Spain.

The purpose of the Congress is to recognise the critical role that aeronautical information will play in the future ICAO air traffic management (ATM) concept. The requirements for the integrity of flight-critical data and the scope of the aeronautical information required by ATM to ensure interoperability exceed the aeronautical information services (AIS) currently being provided.

The objective of the Congress is to bring together originators, processors, publishers, regulators, system designers, service providers and end-users who together constitute the global AIS family. Drawing on collective experience, needs and requirements the Congress will:

■ consider the essential role of AIS in the evolving world of ATM;
■ identify the key drivers for change;
■ explore what must be done to ensure that aeronautical information of the right scope and quality is made available;
■ at a strategic level, review emerging technologies that will facilitate change in a practical and affordable manner;
■ outline a roadmap for the development of aeronautical information, to assist ICAO in the difficult task of leading global change.

In partnership with ICAO, the Congress is being organised by a small but globally representative consortium (Australia, Canada, China, EUROCONTROL, Japan, South Africa and the United States) and will be facilitated by EUROCONTROL with strong support from the Spanish Director General of Civil Aviation and AENA, Spain’s Air Navigation Service Provider.

An impressive list of high-level moderators and speakers is being assembled and the keynote speeches will be given by the FAA Administrator and the EUROCONTROL Director General. We are waiting for a decision from ICAO Montreal on who their speaker will be.

The organisers are committed to ensuring that the global aviation community is fully engaged in the debate. They recognise that aeronautical information transcends national and regional boundaries. Consequently, AIS development must be agreed and coordinated on a global scale.

Industry is being invited to exhibit technology, products and services to demonstrate that change is feasible and available today.

The Congress details can be accessed at www.eurocontrol.int/globalais06, including on-line registration. The response to date is most encouraging.
The conference, the sixth in a series which started in 1997 in Saclay (France), has grown from strength to strength – gathering some 200 international air traffic management researchers in 2005.

The objectives of the conference are to create and reinforce working and personal relationships between leading experts and researchers in the field of ATM R&D, to share available results and to reach a consensus on major issues, with a view to supporting the development of a harmonised global air traffic management system.

During the seminar, three keynote speeches and around 70 presentations on research papers covering a wide range of topics relating to research and development highlighted the challenges and the progress made in this area.

Attendance at the conference was by invitation only and limited to researchers and key decision-makers within the ATM community, as well as to the authors of papers accepted via a call-for-papers process.

The last day was dedicated to plenary sessions, which started with a keynote address by Peggy Gervasy (US Joint Planning and Development Office), followed by two presentations given by Bo Redeborn (Director ATM Strategies at EUROCONTROL) and Steve Bradford (Chief Scientist for Architecture, FAA-ATO) setting out the research priorities of EUROCONTROL and the FAA.

Mr Redeborn gave an overview of the findings of the second version of the Strategic Research Agenda, developed under the Advisory Council for Aeronautics Research in Europe (ACARE), which highlights Europe’s research needs in the field of air transport systems over the next 20 years. He also presented the joint EUROCONTROL/European Commission initiative, SESAME (now known as SESAR), to develop a European Master Plan for ATM research and implementation.

Bradford presented the Next Generation Air Transportation System (NGATS), which is currently being developed by the FAA, NASA, the US Department of Transport and four other State Departments. The 2025 concept for “airport curb to airport curb” was discussed in terms of capabilities and research needs.

On the same day, the traditional ‘Best Paper Awards’ were also presented. The Programme Committee selected the ‘Best paper’ for each of the ten sessions and the ‘Best Presentation’ was chosen by the audience. The European ATM R&D Association EATRADA presented two awards, for the most promising technology and for the best university contribution.

The conference ended with presentations by the session rapporteurs, who highlighted the major findings and challenges of each session. At the end of the conference, an Executive Report was produced, which is available on the Seminar website: http://atmseminar.eurocontrol.fr. This site contains details on all the Seminars held so far, including all papers and presentations, the keynote presentations, the list of best papers and other information.

The next Seminar will be held in June 2007 in Barcelona, Spain.
Entitled “Bottleneck or booster in the future ATM system”, the symposium brought together approximately 100 people, including experts, project managers and decision-makers from policy, air navigation service providers, industry and research in order to discuss the role of airports in the overall air transport system. The objective of the symposium was to illustrate the current situation at European airports and to elaborate on the challenges and perspectives for the future.

With the number of flights predicted to reach 16 million a year by 2020, much more effort is needed in order to prevent airports from becoming the key bottleneck in the future air traffic management system. Potential solutions and their expected benefits were therefore the subjects of presentations. Advanced surface movement guidance and control systems (A-SMGCSs), airport collaborative decision-making and the new airport planner role were highlighted as possible solutions to address the capacity crunch at airports.

The Symposium started with a special session on the most recent institutional changes in the European R&D context and their impact on the technology supply chain concerning airports. ACARE’s SRA2, the upcoming 7th Framework Programme, SESAME (now SESAR) and EUROCONTROL’s research strategy were all discussed in this session. It was concluded with a view on European research policy, presented by Professor Szodruch.

The four subsequent airport-related sessions discussed the views of the stakeholders, development goals and means, solutions and human resource issues.

All speakers paid tribute to Mr Völckers, who was soon to retire, for the important contribution he has made to ATM research throughout his professional career.

This Symposium was the fifth in a series which started in September 2000 with the inauguration of the renovated building of the EUROCONTROL Experimental Centre. The then Director of the Centre, Jean-Marc Garot, had recognised the need to bring together researchers to discuss and exchange research results on a regular basis.

At the same time, new institutional arrangements were proposed by Jan van Doorn, then Director DIS, to introduce new working arrangements, including the ATM R&D Workshops. The aim of these was to complement the R&D feedback loop (strategy – R&D projects – assessment of results – adjustment of strategy) and allow all stakeholders to discuss elements of this R&D cycle, to exchange ideas, thereby creating synergy within the R&D community in specific R&D areas.

As SESAR starts to take shape, it is envisaged that this type of get-together of the key players in European ATM research will become an integral part of this key programme, which for the first time brings together all stakeholders of the European air transport system.
Entitled “How can wake vortex separation standards be revised?”, the workshop examined possible changes to the distances or times that must be maintained between aircraft in flight as a result of advances in research on wake vortex – the swirling air left in the wake of aircraft in flight.

The International Civil Aviation Organization (ICAO) has established separation standards between aircraft varying from three to six nautical miles as a function of the aircraft’s weight category, in order to ensure that other aircraft do not get caught up in the wake vortex of the leading aircraft. However, given the significant progress that has been made recently in understanding how wake vortex behaves, the workshop concluded that it is necessary to improve wake vortex separation standards so as to mitigate congestion especially at airports while maintaining current levels of safety.

Participants at the workshop included EUROCONTROL experts and researchers, European research institutes, industry, air traffic management organisations, regulators, airlines and airport authorities and other bodies such as the FAA*, NASA* and WakeNet-Russia.

Reflecting the very fruitful cooperation between Europe and the USA on this issue, moderators and speakers from both sides of the Atlantic alternated in sessions.

Session 1 of the Workshop pointed out the need to improve the current situation at major airports. Speakers from airports and airlines described the demand for more runway capacity and better regularity and punctuality in response to traffic growth or the impact of weather.
Airport benefit studies conducted for the USA and Europe showed clear potential benefits from ongoing projects such as time-based spacing for single runway operation and reduced diagonal separation for closely spaced parallel runways.

**Session 2** explained the regulatory processes for establishing standards. Specialists described individual processes to be used in order to comply with ICAO, JAA, FAA and EUROCONTROL requirements (ESARR*).

**Session 3** addressed the requirements for building a safety case with a view to revising wake vortex separation. The elements discussed included the overall safety case argumentation, quantitative wake encounter risk assessment methodologies and vortex encounter severity analysis and acceptability.

**Session 4** was devoted to case studies of wake vortex safety assessment. The current practice at London Heathrow was presented as an example for consideration by projects aimed at maintaining runway capacity regardless of weather conditions.

Time-based spacing was proposed as a response to significant headwinds to ensure arriving capacity resilience. *(1)*

Large-scale wake vortex data collection conducted at Saint Louis Missouri (USA) was analysed to show possible reductions in diagonal distances between closely spaced parallel runway approaches for medium and small aircraft. *(2)*
A special session was held by WakeNet-Russia presenting its wake vortex operational research programme and proposal for collaboration with Europe and the USA. Taking advantage of satellite positioning and ADS-B communication enabling aircraft data exchange, Dr Andrei Belotserkovsky also suggested a joint innovative research project for the integration of wake vortex warnings into aircraft avionics.

“The WakeNet2-Europe final document recommended additional level studies to increase airport capacity”

Session 5 gave the stakeholders the opportunity to discuss the wake vortex issues and express their views on the current and future situation:

- Pilots clearly recommended that future work pay particular attention to preventing an increased risk of wake encounters at low altitudes and also suggested the development of onboard system detection systems.
- Controllers recognised the clear convergence towards operational use of the three different WakeNet-Europe workshops. “It is now time to merge research and operations more aggressively” said Isa Alkalay from Skyguide, Switzerland.
- Airlines and airport representatives cited the need to increase capacity and provide evidence of a full safety case. “Systems should be kept simple to enable easy and safe day-to-day operations” said Paul Johnson from NATS, UK.
- Professor Winckelmans from Université Catholique de Louvain (UCL) called for field trials to allow local safety cases and further refine wake vortex models. Relative safety cases were considered sufficient and more practicable than absolute targets.
- Industry reported that it can now either provide the technology to support the operational changes or assist in gathering the necessary background information.
Session 6 concluded the Workshop.


With the aim of promoting the exchange of information between specialists on wake turbulence and developing a shared view on how to address safety and capacity problems caused by wake turbulence, the WakeNet2-Europe final “Research Needs Document” reported on the state of the art regarding wake vortices and recommended additional high-level studies on various operational scenarios proposed to increase airport capacity without loss of safety. These studies should be extended into more detailed analyses taking into account specific site dependencies in order to determine local operational scenario benefits and applicability.

Recent research results had shown that knowledge of wake vortex behaviour was sufficient to allow implementation of near-mid-term solutions if local wake measurements and operational studies are conducted. Identified projects are:

- reduced separation for take-off and landing in crosswinds;
- time-based spacing for landings in strong headwinds;
- reduced diagonal separation for medium aircraft where there are closely-spaced parallel runways;
- visual separation for departure and arrival.

In order to enable robust validation of Wake Vortex projects, particular attention should be given to the following recommendations:

- Site-specific data is necessary to validate wake vortex sub-models prior to demonstrating required safety arguments for appropriate operational concepts at individual airports.
- Data collection, field trials and wake vortex detection and forecasting systems should be implemented in parallel.
- Incident reporting should be developed to monitor wake encounters.
- Longer-term research should investigate wake encounter severity and acceptability.

For a particular concept such as time-based spacing, validation will demonstrate the relevance of working methods via real-time simulations, and safety requirements will be provided with wake vortex data collection at a particular airport in order to enable a formal safety argument to be established.
Mediterranean Free Flight
Final Workshop

On 1-2 December, the Mediterranean Free Flight (MFF) Programme held its final workshop in Rome. It was an opportunity for over 150, mainly European professionals involved in the development of ATM concepts, procedures and systems working for airlines, air navigation service providers, civil aviation authorities, industry, international agencies, military authorities and policymakers to get an executive view of the achievements of the Programme.

The workshop was opened by General Bruno Nieddu, President of ENAV, followed by Christopher North, from the European Commission Directorate-General for Energy and Transport, and Jan van Doorn, Director of the EUROCONTROL Experimental Centre. Over the following two days, representatives of the Programme’s partners presented results obtained which were then put in perspective by speakers from outside the Programme such as the FAA, NASA, the SESAR Executive Committee, IFATCA, Airbus and Alitalia. The closing round table was an opportunity to further highlight the significance of the MFF Programme results as well as the remaining challenges.

MFF was a pre-operational programme aimed at developing and validating procedures for the future ATM operational concepts within the Mediterranean area between the European core area and the States of North Africa and the Near East. It was conducted between 2000 and 2005 by a consortium led by ENAV (Italy) in partnership with AENA (Spain), DSNA (France), EUROCONTROL, HCAA (Greece), MATS (Malta), NERL (UK), NLR (NL) and SCAA-LFV (Sweden). The MFF Programme was co-funded by the European Commission within the Trans-European Network for Transport (TEN-T) framework. Its total budget over the five years exceeded EUR 50 million.

The main objectives of the programme were:

- to define operational requirements and procedures based on the use of new CNS/ATM;
- to identify technologies enabling the introduction of ASAS*
operations;
- to verify appropriate new operational procedures for controllers and aircrew in free route and ASAS scenarios through simulations and flight trials using specially equipped controller working positions and aircraft;
- to pursue the exploitation and standardisation of the new CNS/ATM technologies;
- to define guidelines for the implementation of ASAS operations in appropriate airspace.

As the Mediterranean airspace is a transition area between the core area (high-density traffic and good CNS infrastructure) and the North African airspace (low-density traffic and poor CNS infrastructure), the MFF Programme decided to evaluate the feasibility of a large range of applications leading towards user-preferred flight trajectories, and redistribution of tasks between controllers and aircrew in en-route scenarios for both Free Flight Airspace (FFAS) and Managed Airspace (MAS), and also to study the transition between the two.

On the basis of an analysis of user expectations and of current traffic constraints, the MFF partners agreed to focus on a structured series of increasingly innovative and challenging applications designed to improve the management of air traffic in the Mediterranean area. Specifically, five applications to be studied were identified:

- Free routes application;
- Air traffic situational awareness application;
- ASAS spacing application;
- ASAS separation application;
- ASAS self-separation application.

This classification allowed for a smooth progression of different operational concepts towards innovative CNS/ATM concepts applicable to the Mediterranean basin. The inclusion of the military in all the discussions from the start of the Programme should also be highlighted as a key feature. There were substantial contributions from the Italian Air Force, the EUROCONTROL Military Unit and subsequently the French DIRCAM®. The US Navy also took an interest at various stages owing to their interest in Mediterranean operations.
The MFF validation process was conducted using the structured MAEVA* approach (now E-OCVM). Concepts and procedures were validated against a predefined set of validation objectives through a co-ordinated and integrated set of validation exercises. The process was supported by the pioneering use of the Validation Data Repository (VDR): it held the details of results from all the MFF validation exercises mapped to the relevant validation objectives and organised in accordance with the MFF Operational Concept application. It enabled structured validation reports to be produced throughout the project. The validation exercises included nine model-based simulations and nine high-fidelity real-time simulations of both ground and airborne aspects which were conducted in Italy, France, the Netherlands and Sweden. It also included three successive safety cases. The programme culminated in a series of live flight trials over the Mediterranean involving four aircraft for a total of 240 flight hours.

MFF has published over 6,000 pages of official documentation which can be found on the MFF website (http://www.medff.it), and an even greater quantity of working papers. The MFF Final Report in just 80 pages provides a very good summary of the project, its results and conclusions. At the risk of massive over-simplification, these may be summarised even more briefly as follows:

- Free route exercises carried out by DSNA globally confirmed what was learned from Agency studies such as FRAP*. In particular there was no clear evidence from real-time simulations that significant capacity gains can be obtained from systematic use of free-routing. In some cases safety issues were raised, with vertical transitions posing particular problems. ENAV simulation results were more positive, indicating that subject to certain requirements, the free route concept could be applied in medium/low-density airspace offering some 3% reduction in the mileage flown.

- As regards ASAS spacing applications, sequencing and merging was judged feasible, and within certain operational contexts can have some beneficial impact on controller workload. Impact on pilot workload was considered to be within acceptable limits. ATM efficiency could be improved with sequencing and merging procedures if these were associated with appropriate airspace revisions. ASAS passing procedures were also well appreciated, particularly by pilots. On the other hand, ASAS crossing was poorly accepted, and the project concluded that this application should not be categorised as ‘spacing’ (as per POASAS taxonomy). The main factor was the high closure rates associated with crossing applications where the controller cannot be expected to retain responsibility for separation assurance.

- ASAS separation was shown to be useful in specific conditions (e.g. portions of the Mediterranean with limited radar coverage). The lower level of maturity of the application limited the depth of the safety analysis. There were particular problems in understanding the division of responsibilities between air and ground. The issue of the exact values for airborne separation minima (potentially leading to inefficiencies) plus a number of critical points like the use of intent, the detection and recovery from failures still remain to be addressed.

- Finally, ASAS self-separation (free flight) appeared to be potentially highly beneficial. No show-stoppers were found even in challenging environments. This is the most advanced of the applications tested and represents a genuine ATM paradigm shift.

In conclusion, the MFF Programme has been an effective exercise in international cooperation to develop European consensus on new innovative ATM techniques and technology options.

It enabled experts from all over Europe to cooperate in overcoming the operational and technical hurdles in defining and validating future concepts and their safety implications. The Programme went on to develop advanced simulation facilities and new validation techniques plus a live trials environment including fully equipped flight test aircraft. MFF has produced detailed results concerning the feasibility of a large range of applications leading towards user-preferred flight trajectories, redistribution of tasks between controllers and aircrew, and making use of the possibilities offered by ADS-B* services. The potential of ASAS spacing (sequencing and merging) to improve the handling of arriving streams of aircraft was confirmed. The feasibility and benefit of a paradigm shift led by ASAS self-separation were also reinforced.
Why socio-economic research at the Experimental Centre?

Both government and industry are integrating into their strategies increased attention from citizens, new consumer activists and environmental groups. By committing to an ethically responsible way of doing business, a number of industrial sectors have even been able to create a new method of governance and to gain a real competitive advantage in a changing world.

Like other sustainable mobility sectors, the air transport industry faces the challenge of building a constructive dialogue with stakeholders whose interests are not always compatible with the concept of sustainable development. In this context, air transport stakeholders, such as users, customers, citizens, decision-makers and, sometimes, "victims", require air traffic management (ATM) to show more organisational transparency. Therefore, ATM is questioning its working practices, business models and organisational culture.

“...faces the challenge of building a constructive dialogue with stakeholders whose interests are not always compatible with the concept of sustainable development”

Over the last ten years and in line with European-Community policy, EUROCONTROL has become progressively more active in taking account of air traffic management’s impact on the environment. Through the continued development of analytical tools, together with environmental studies and research, the EUROCONTROL Experimental Centre (EEC) has become a focus of excellence in the modelling and assessment of environmental impact, from a local as well as a global perspective.

During the search for strategic orientation, a need has been identified to conduct more research into the societal and economic aspects of air transport. The Society-Economy-Environment (SEE) Research Area of the EEC is in charge of looking at these societal, economic and environmental aspects. It aims to provide the air transport industry and policymakers with an increased understanding of these aspects and their evolution in order to enable better-informed decisions.

Why a workshop?

Initial exploratory research over the last few years has produced a better understanding of issues relating to society, economics and sustainability in air traffic management. There was a need to disseminate these results while showing how they interrelate to build a complex picture of the benefits and threats brought by air transport and air traffic management to society.

To this end, the first SEE workshop was organised on 5 December 2005 at the EEC. It included an adversarial debate, with invited speakers, on the sustainability of air transport. The key objective of the workshop was to ensure the wide dissemination of results while encouraging an exchange of views and openness to outside debate. It was also an opportunity for increased networking in a research community whose members come from very diverse horizons.

The workshop aimed, in particular, to point out to decision-makers that a common effort should be made in order to better understand and adjust the changing world of air traffic management to meet the challenge of sustainability. By doing so, the SEE Research
Area seeks to actively contribute to identifying new synergies and to foster cultural change within air traffic management.

**Presentations**

The first part of the workshop was organised on the basis of sessions, each of which aimed to present the state of knowledge in relation to one aspect of air transport’s effect on society (the environment, the economy, society’s perceptions), and then in relation to the complexity of integrating them into the concept of sustainability for air transport. These sessions included presentations of the following studies initiated by or involving the Society-Economy-Environment Research Area:

### Session 1: Air transport and the environment
- Overview of environmental research at EUROCONTROL

### Session 2: Economic aspects of air transport
- The economic catalytic effects of air transport in Europe
- ATM market evolution resulting from deregulation
- Economic aspects of intermodality (MODAIR)
- Evaluation of aircraft noise pollution: A comparison of approaches in the context of airport relocation

### Session 3: Societal perception of air transport
- Analysis of European press relating to ATM safety
- Politicians’ views regarding air transport growth
- Air transport growth: An insight into the citizen’s view
- Evaluating pollution from aircraft noise

### Session 4: Sustainable air transport
- Environmentally sustainable airports
- What’s new in sustainable development? Theoretical paradoxes and the problem of coordination
- SUSTAIN: A framework for sustainable aviation

### Debates

The workshop concluded with a “British-parliamentary-style” debate, with four speakers proposing and opposing the following motion:

“This house believes that air transport can be socially, economically and environmentally sustainable in the short and long term”

The structure of the debate allowed each “camp” to state their main arguments for and against the motion. This first phase was followed by a long exchange of questions, answers and statements with the audience, and finally a vote.
Arguments presented in the opening speeches

Proponents

- Air transport has a freedom-of-movement mandate from the world community.
- Accessibility: mobility is a right, not a privilege.
- Benefits of aviation in two figures: total aviation-sector contribution of $2.960 billion to world GDP and 29 million people working for the aviation sector worldwide.
- The world is not sustainable, but human and competitive organisations find ways to survive.
- The industry is able to mitigate impacts.
- Air transport sustainability requires international cooperation, which must be organised by States.
- Economic instruments can make a contribution, but the solution will be through technology and standards.

Opponents

- Environmental problems are global, reflecting the character of our society as a whole: our current version of capitalism must sustain growth in order to maintain capital accumulation.
- The environmental impact of air transport will not diminish.
- We must do something about our addiction to fossil fuel; we have to use less.
- Growth outpaces technology: every year for the next 50 years, there will be approximately 1% fuel efficiency per annum from engine and airframe technology and more than 1% improvement from CNS/ATM. Growth in emissions is 3-4% per annum.
- In the fight against climate change, air transport is in the front line.

Main statements from the floor and their replies

Floor: New technology using other fuels will become available and aviation will be sustainable
Floor: Rail is not better in terms of fuel.
Floor: The question should be “is society sustainable without air transport?” It certainly is not.
Opp.: The issue is not how much fossil fuel remains but the size of the gaseous emissions we are producing today.
(Prop.): Right of developing countries to develop.
Opp.: Off topic.

Floor: Regulation can change technology (e.g. Chapters 1, 2, 3 and 4 for noise).
Opp.: Technology will not change quickly enough.

Floor: Flying is fun and therefore sustainable.
Floor: What are the choices between emissions sources?
Opp.: Reduce by 60 to 80% the ten tons of CO2 emissions produced per year by every household in Western Europe by the middle of this century...

Floor: Pollution comes from the rich 5% who fly.
Prop.: Some rich people suffer from pollution and still ask for airport growth.
Prop.: We want 95% of the population to fly, but taxes will reduce the flying population to 1%.
Opp.: Taxes will not reduce the flying population; the growth will simply be smaller.

Floor: Whereas low-cost aviation is not sustainable, business aviation could be.
Floor: Are there any credible industry-adaptation scenarios, such as fewer flights and bigger aircraft?
Prop.: 4% traffic growth produces only 2% of fuel growth, owing to the productivity benefits of airports, airlines and ATM services. If there was less money, these benefits would disappear.

Floor: There is a price at which air transport can be sustainable.
Floor: Mankind finds solutions to the problem of stagnation.
Opp.: The air transport industry is not sustainable; we require some large systemic changes, technological advances and different approaches to mobility.

Floor: Sustainability is not definable: abstain.

- Demand management: if we keep the cost of flights at one euro plus taxes and charges, fossil fuel addiction will not change: a tax on air fuel, paying the social cost of the environmental impacts, would probably halve growth rather than stop it: 1% to 2% per annum.
- Sustainability includes the short and the long term. In the short term, air transport today is not compatible with the drastic reduction of greenhouse-gas emissions required to cope with climate change: an 80% reduction from today’s levels by 2012.
Vote

Excluding abstentions, exactly half of the voters agreed with the motion and exactly half disagreed. This result was rather surprising for some participants, as it seemed to reflect a societal trend of growing environmental awareness while revealing contradictory forces inside the aviation community itself.

Lessons learnt

Air transport sustainability is not a simple issue and there is no technical solution; a lot of "soft" issues are involved, as the objective is a collectively agreed balance between contradicting outcomes which have effects on different temporal and geographical scales; this involves specific coordination between aviation stakeholders, one of which is society. Beyond factual reality, the more fundamental political or philosophical facets of sustainability emerged throughout the workshop and were exposed during the debate. They included opinions and beliefs in relation to the prevalence of short- or long-term issues, trust in progress and industry, fairness and equity between citizens, and societal choices and responsibility.

The workshop, thanks to all the contributors (organisers and speakers), allowed a level of reflection and thinking beyond the one-way communication achieved through presentations. The final debate brought about a wide exchange of views, going beyond the usual positions to come closer to the core opinions of participants. Overall, the participants were made aware of some of the debates which are taking place in some areas of European society.

The positive reactions to this first workshop and the high level of participation in the event reveal the interest for both the socio-economic and sustainability-related aspects of ATM in air transport, and also for this form of dissemination of results. Many useful suggestions have been provided for improvement in terms of both form and content. Enriched by this first experience, further workshops are envisaged.

In conclusion, the workshop has provided space and food for thought about some socio-economic aspects of ATM in air transport and about air transport sustainability, contributing to EUROCONTROL’s initiatives to improve the response of ATM to society’s expectations.

Special thanks to the workshop team: Véronique Prou, Elisabeth Plachinski, Pete Hullah, Béatrice Lapeyronnie, Patricia Cauwenbergh, and to all colleagues from other services, in particular Mark Whiteley, Martina Jurgens, Marc Brochard, Hervé Bechtel, Werner Lembach, Catherine Gilleron and Julia Sanchez for their excellent work.

More information on the workshop can be found at:

http://www.eurocontrol.int/eec/see/public/standard_page/workshop_2005_home.html
On 14-16 February 2006, EUROCONTROL took part in the ATC Maastricht Conference and Exhibition. Over the last fifteen years, ATC Maastricht has become the industry’s major annual showplace, attracting the world’s leading suppliers and buyers. More than 4,000 visitors – mainly senior and middle managers from civil aviation authorities, government departments, air navigation service providers, airlines and airport authorities from nearly thirty countries worldwide attended this year’s ATC event.

**ATC Maastricht exhibition**

EUROCONTROL once again participated, displaying its key projects at a 170 m² stand. Visitors to the stand were able to watch the following demonstrations:

- DMEAN – Dynamic Management of European Airspace Network
- AOP – Airport Operations Programme
- Safety
- FASTI – First ATC Support Tools Implementation
- TCT – Tactical Controller Tool
- TBS – Time Based Separation
- 4D Trajectory
- FARADS – Feasibility of ACAS RA Downlink Study
- ATM Learning Online
- E-conferencing
- OATA – Overall ATM/CNS Target Architecture
- SESAR – Single European Sky ATM Research

**ATC Maastricht conference**

The 2006 ATC Maastricht Conference entitled “Reshaping Air Navigation Services for the twenty-first Century” examined the operational, technical, institutional and regulatory implications of global initiatives to provide safer and more efficient air navigation services for the future. It brought together key decision makers from the ATM industry worldwide and enabled delegates to hear the views of industry leaders from air navigation service providers, government civil aviation departments, regulators, global safety organisations, airspace users, airports, military aircraft operators and all stakeholders – including controllers and pilots.

From the EUROCONTROL side, the Director General, Víctor M. Aguado, delivered a keynote address at the Conference entitled “Strong cooperation for enhancing air traffic management performance”. Other presentations included “Progress towards a truly flexible use of airspace” by Alex Hendriks, Head of the Airspace, Flow Management and Navigation Business Division; “Dynamic Management of European Airspace Network (DMEAN)” and “Releasing latent capacity in Europe” by Joe Sultana, Head of the Airspace Capacity Business Division; and “SESAR – a long-term strategy for a new European ATM network” by Bo Redeborn, Director of ATM Strategies.

Since their creation seven years ago, the PRC and PRU have turned performance review into a powerful reality. It is a widely held view that the PRC has established an undisputed moral authority. Its messages are acknowledged as authoritative, often leading the way on difficult subjects, including: independent study on ATFM, disclosure of financial information, US-Europe comparisons on productivity and efficient use of capacity.

More recently, the European Commission has invited the PRC to evaluate the impact of the Single European Sky initiative on ATM performance. It is a challenging task, which the PRC has agreed to take on.

**ATC Maastricht awards**

Over the last five years the annual ATC Maastricht Awards has recognised excellence within the air traffic management industry and has raised awareness of significant contributions to air traffic safety, capacity and efficiency. This year was equally successful with a total of six awards presented at the ceremony. The Contribution to European ATM Award was presented to EUROCONTROL’s Performance Review Commission (PRC) and the Performance Review Unit (PRU), and was accepted by Keith Williams, the PRC Chairman, and Xavier Fron, Head of the PRU.
The purpose of ACE is to promote cooperation and coordination in ATM matters between the States concerned as well as with ICAO, EUROCONTROL, the European Union, airspace users, industry and international institutions (including financial institutions). The ACE Memorandum of Understanding was signed on 8 July 2003 by the Directors of Civil Aviation of Bulgaria, Moldova, Romania and Turkey.

The main issues on the agenda included a review of progress made by the three ACE working groups (Framework for ANS, ASM and CNS) in which EUROCONTROL participates with observer status, developments at the EU with respect to the implementation of the Single European Sky (SES) and the progress made by ATSA Bulgaria and ROMATSA with the Initiative for Creating the Pre-requisites for the Establishment of a Functional Airspace Block (FAB). There were also a number of presentations on ATM issues. EUROCONTROL representatives gave briefings on air traffic forecasts, FABs, safety, the SES from the National Supervisory Authority perspective and regional ATM cooperation.

Ukraine was represented at the meeting and was accepted as the fifth ACE member.
The top 10 city-pairs by region (as measured by total passenger numbers in 2004) have been sourced from IATA’s On-Flight Origin-Destination Statistics (ODS) data collection, a monthly collection representing 70% of international passenger traffic. Passenger numbers for 2003 are also shown for comparison purposes.
Global Air Traffic Management: The Role of Europe and North America

A unique forum for transatlantic ATM issues
- global ATM interoperability
- civil-military cooperation
- satellite navigation: GPS and Galileo
- technical, operational and economic developments

6 - 8 June 2006, Brussels

US ATCA/EUROCONTROL Technical Symposium & Exposition supported by NATO

Information and registration www.atca.org
It was back in the spring of 1996 when the old staff journal known as SKYWAY was transformed into a magazine. This move was part of a series of initiatives aimed at improving EUROCONTROL's communications, both internal and external.

“We want to enhance the Organisation’s image and make its role, structure and function more widely known”, said Yves Lambert, the Director General at the time, in his first editorial. “We have launched a new communication strategy which includes a large-scale programme of information sessions, new brochures and increased participation at a variety of exhibitions.”

The magazine was seen as a pivotal element in the new communication strategy and its main objective was to present EUROCONTROL’s latest projects and plans as well as to provide a forum for constructive dialogue.

Over the past ten years, the editorial team has continuously sought out ways to improve the magazine, making it a key communication tool for the Agency.

Published four times a year, Skyway has focused on feature articles dealing primarily with specific domains and covering key developments in air traffic management rather than news items. At the same time, the editorial policy of the magazine has always been to provide readers with the widest possible range of insights. To this end, Skyway has given the floor to key players in the aviation community at large. Many people have been put in the spotlight and interviewed, and their opinions regularly reported. These have included: leading figures from international organisations, airlines and air traffic service providers, as well as air traffic controllers, pilots and senior officials from the national authorities and industry.

In a bid to be innovative and to always keep our readers interested, since 2002 each edition of Skyway has been devoted to a specific topic which is dealt with in depth and from various perspectives. In turn, the editorial has increasingly become an important platform for the Director General to provide his thoughts and perspective on various topics while
highlighting the progress made and the challenges facing the Agency.

Over the years, Skyway has gone from strength to strength: expanding its readership significantly (up to a current circulation of around 7,000 copies), bringing in new features and introducing a gradual restyling involving the adoption of a new format in 2001 and the introduction of a new graphic design and logo in 2003. Furthermore, since 2002 Skyway has been available online – reaching our readers faster and more effectively than ever before.

Today the magazine remains a key communication medium with which to position the Organisation in the world of air traffic management, keeping readers abreast of key developments in the Agency as well as in the aviation community. Each issue of Skyway is a proof of this Organisation's major achievements as well as a source of information and expertise in air traffic management, this being our Organisation's unique strength.

The Skyway editorial team aims to continue improving the quality of the magazine and is always exploring new ideas. In this issue of Skyway we are introducing a new layout and two new sections entitled “SESAR” and “Industry News”. To mark the importance of the SESAR programme, we will henceforth report on the progress made in the Definition Phase of SESAR – the Single European Sky Implementation Programme. The “Industry News” section will report on a wide range of information items, including new appointments, statistics, developments, new programmes, etc.

On its tenth anniversary, the Skyway editorial team would like to thank all those people who have contributed articles over the years and have been involved in making this magazine a success.

We would also like to take this opportunity to ask you to send us an email and tell us what you think of our magazine and what you would like to see in forthcoming issues.

We hope that Skyway has been a useful and reliable source of information. For our part, we are still committed to introducing fresh ideas and adapting to meet our readers’ needs.

Thank you!

Send your comments/thoughts to the Skyway Editor, Lucia Pasquini at lucia.pasquini@eurocontrol.int
Armenia has been a member of the International Civil Aviation Organisation (ICAO) since July 1992, joined the European Civil Aviation Conference (ECAC) in December 1996 and became member of the Joint Aviation Authorities (JAA) in 2003.

**Civil aviation**

Civil aviation in Armenia is the responsibility of the General Department of Civil Aviation (GDCA) under the authority of the Prime Minister and the Government. ARMATS is the air traffic service provider in Armenia. As enterprises operating in the field of civil aviation, both ARMATS and Zvartnots International Airport are under the regulatory control of the General Department of Civil Aviation. ARMATS is an independent State joint stock company, while Zvartnots International Airport is State-owned but is operated by a private international company. Both companies are completely separate and independent from the GDCA.

ARMATS provides air navigation services, including air traffic control, communication, navigation, surveillance and aeronautical information services in the airspace of the Republic of Armenia. The company was founded in 1997. In 2003 the airports of Gjumry and Stepanavan were also included in the structure of ARMATS. This structure facilitates the implementation of common policies for the provision of air navigation services in Armenia. In turn, this set-up contributes to the enhancement of the safety of air traffic services and their compliance.


Armenia joins EUROCONTROL

By Raffi Khatcherian, Project Manager, Stakeholder Implementation Service DAP/SIS

Armenia has been a member of the International Civil Aviation Organisation (ICAO) since July 1992, joined the European Civil Aviation Conference (ECAC) in December 1996 and became member of the Joint Aviation Authorities (JAA) in 2003.

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with international and EURO-CONTROL safety regulatory requirements.

In cooperation with the General Department of Civil Aviation of Armenia, ARMATS has spared no effort in modernising its air traffic management system in line with ICAO and EUROCONTROL regulations and procedures. New air traffic services routes have been implemented connecting south-eastern Asia with Europe, and the Middle East with northern Europe and the CIS countries.

The accession of Armenia to EURO-CONTROL brings the Organisation’s goal of a seamless air traffic management system right across the continent one step closer.

1998
- Convergence and Implementation Programme (CIP) Document development in cooperation with EUROCONTROL

1999
- Publication of the first Local CIP of Armenia

2000
- Modernisation of the aerodrome radar “IRTISH” and exploitation of the modernised en-route radar “TRLK-11” to provide double radar coverage
- Modernisation of the VHF communication system and network and exploitation of the “Mravyan” VHF remote centre (at 2850m above sea level)
- Modernisation of the Yerevan ATC Centre with the installation of a new ATC system, EUROCAT-1000 (Thales), and a digital voice communication system, TXM-44000
- Installation of regional satellite-based voice communication system “Phonesat” (EUROCONTROL VSAT system) to establish ground/ground communications with the adjacent Area Control Centres (ACCs)

2002
- Start of the development and implementation of national regulations in compliance with ICAO Standards and Recommended Practices, together with the GDCA

2003
- Implementation of ICAO vertical separation using the imperial system
- Airspace classification in compliance with Single European Sky and EUROCONTROL requirements
- Start of civil/military coordination

2004
- Integration of all navigation services of civil airports in “ARMATS” and creation of a single air navigation service provider in Armenia
- The start of the implementation of safety management system
- Foundation of Aeronautical Information Services (AIS), NOTAM office and integrated Briefing, Publication of the first Aeronautical Information Publication (AIP) of Armenia
- Implementation of new information technologies in AIS, development and publication of electronic AIPs in accordance with EUROCONTROL requirements
- Implementation of new ATC procedures in accordance with international ICAO standards
- Implementation of quality management system and certification of AIS in accordance with ISO 9000-2001 international standards

2005
- Implementation of Reduced Vertical Separation Minima (RVSM)
- Installation and modernisation of “NITA” simulator and creation of “TOWER” simulator
- Installation of a new ILS/DME CAT 2-3 at “Zvartnots” airport
- Installation of P3D, a surveillance system based on multilateration, to ensure stable double radar coverage and even triple coverage for some portions of the airspace

**Capital:** Yerevan  
**Population:** 3,200,000  
**Area:** 29,800 km²  
**Main airport:** Zvartnots  
**Air passengers:** 1,089,643 (in 2004)
NATS appoints new Safety Director

7 March 2006 – National Air Traffic Services (NATS), the UK’s leading air traffic services provider, has announced the appointment of its first woman Director of Safety.

Gretchen Burrett, who led NATS’ Human Factors team for three years and is currently Head of Safety and Performance Improvement, is an internationally recognised expert in human factors, and respected throughout the industry for her knowledge and leadership in safety performance.

Gretchen will take over on 1 April from Fergus Cusden, who is to become General Manager of Luton Airport, to widen his general management and business experience.

Jerry V. Liston appointed as Chairman of the Irish Aviation Authority

15 February 2006 – Jerry Liston is Executive Chairman of The Michael Smurfit Graduate School of Business, UCD. He is Chairman of BWG Group, Kevin Broderick Ltd. and Balcas Timber Ltd and is also a Board Member of Glanbia plc. Previous Directorships include Development Cooperation Ireland, the Arthritis Foundation, NTR, Lake Communications and the Gresham Hotels. He was Chief Executive of United Drug plc. from 1974 to 2000.

He is past Chairman and Board Member of The Marketing Society of Ireland and past President, Chairman and Board Member of the Irish Management Institute.

Commenting on the announcement and welcoming the appointment of Jerry Liston as Chairman of the Irish Aviation Authority, Eamonn Brennan, CEO said: “The Authority and Irish aviation will benefit greatly from this appointment. Jerry Liston brings with him an unrivalled mix of educational and business experience at the highest level which will be invaluable to the Authority in meeting the growing challenges in aviation safety regulation and air navigation service provision.”

Roberto Kobeh González elected President of the Council of ICAO

Montreal, 2 March 2006 – the Council of the International Civil Aviation Organization (ICAO) elected Roberto Kobeh González as its President, beginning 1 August 2006. He will succeed Dr Assad Kotaite and will remain in the post until the President elected by the next Council in the Autumn of 2007 takes up office.
5 February 2006 – Madrid Barajas Airport opened the new €6 billion Terminal 4 and its satellite, adding capacity for a combined 35 million passengers per year. The departure hall in the main terminal holds 172 check-in desks, including two for special luggage, and ranks of shared self-service kiosks. With a floor surface of 470,000 square metres, T4 is 1.13 km long. It has 38 gates and can handle 20 million passengers per year.

The satellite terminal is 930 m. long, has a floor space of 287,000 square metres and boasts a capacity of 15 million passengers per year. It has 26 gates, 16 of which feature double piers. The people-mover connecting the two buildings covers a distance of 2.1 km and can transfer 13,000 passengers each hour. The new automated baggage system can handle 16,500 items per hour.

Outside, the road approaching the main terminal building has 12 lanes – six each for departures and arrivals – with three dedicated lanes for taxis, two for buses and one for private vehicles in each direction. The car park holds 9,000 cars.

Two new runways also opened at Madrid Barajas, upping the airport’s capacity from 78 to 120 aircraft movements per hour and almost doubling its passenger capacity to 70 million passengers per year.

Wolfgang Mayrhuber appointed
AEA Chairman for 2006

3 January 2006 – The Association of European Airlines, which represents 30 major airlines in Europe, has announced that Wolfgang Mayrhuber, CEO and Chairman of the Executive Board of Lufthansa, will be the Association’s Chairman for 2006.

The new Chairman of the JAA Board (JAAB) is Mr Thorgeir Palsson, Director General, Civil Aviation Authority Iceland.

His appointment has been effective since 6 December 2005. Chairmanship of the JAAB is usually held for a term of four years.
The story so far

The purpose of SESAR – Single European Sky (SES) ATM Research – Programme is to bring together the means to modernise the current European air traffic management (ATM) system and accommodate future air traffic with a high overall ATM performance. Its Definition Phase (2005 to early 2008), jointly funded by EUROCONTROL and the European Commission (EC), will deliver a European ATM Master Plan, the road map of actions for implementation.

The Definition Phase is executed mainly through a EUROCONTROL contract by a consortium representing the entire ATM community, in order to obtain maximum buy-in to the resulting recommendations. The Agency also contributes significantly in terms of:

- furnished deliverables; current or planned results of its work to be taken into consideration in the different tasks; taking stock of existing knowledge and preventing duplication of work;
- effort to directly contribute to the work packages.

The Definition Phase contract was signed in November 2005 with the SESAR Consortium, composed of 30 companies and organisations (see logo picture below), with some 20 other associate companies and subcontractors. Since contract signature, detailed work statements for the various work packages and tasks and project management-related documents have been finalised and agreed, including the Agency’s contribution.

The work will be divided into six main steps and their key deliverables as illustrated in the figure 1 together with the scheduled timeline (in months) from the actual start of work (T0), 7 March 2006.
Consultation and communication

In the spirit of the project, some key characteristics of its deliverables are: added value, evidence of buy-in, absence of bias, documented rationale and overall quality.

This is why the consortium is required to communicate extensively and create a sense of buy-in on the findings and recommendations of its work. A comprehensive Communication Management Plan has been defined which describes the processes and actions involved. Such communication will ensure awareness and buy-in within the participating organisations up to the executive levels, and must also reach non-participating organisations inside and outside Europe. In doing so, maximum use will be made of the existing working, consultation and cooperation arrangements. In addition, workshops will be organised for each of the main deliverables.

As part of the communication process, Skyway will devote space to a report on SESAR in each upcoming issue and briefly present:

- the work in progress and to be launched before the next issue, highlighting the main topics to be addressed;
- achievements and deliverables since the previous issue and important facts or actions.

In line with this initiative, the table below summarises the current situation:

<table>
<thead>
<tr>
<th>Achievements</th>
<th>Milestone 0</th>
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Scheduled delivery to Agency: 7 July 2006

The Milestone Deliverable D1 will capture the strengths and shortcomings of the current situation and “marketplace” and consider the major factors shaping and influencing the air transport industry today, such as the macro-economic situation; public opinion and the expectations and roles of, and relationship between, each major stakeholder group. D1 will document the current situation relating to each of the major subject areas which make up the air transport industry today; the approach to the conduct of ATM; the positive and negative aspects associated with all of the above and the activities which are already in progress to improve the current situation in the short-term. The aim is to agree that this is the basis for the further work.

| Next feedback | D1 Workshop: Mid-September 2006 |
On 10 March, the Director General of EUROCONTROL received Mr Matthias Ruete, Director General of DG Energy and Transport (centre). Various topics were on the agenda, including relations between the European Community and EUROCONTROL, the Single European Sky support for regulations, the SESAR programme and ATM safety regulation.

On 6 March, Mr Jacques Barrot, Vice-President and Transport Commissioner of the European Commission, visited the Maastricht Upper Area Control Centre.

On 28 February, Colonel Luc Vervoort, Head of the EUROCONTROL Military Business Division, met with Lt. Colonel Pantelis Christophorou, Military Representative of the Republic of Cyprus, in order to discuss civil-military issues.

On 24 February, a delegation from the Situation Centre at NATO Headquarters visited EUROCONTROL. The delegation was briefed on the civil-military dimension of European air traffic management, including security and the flexible use of airspace.

On 6 February, Mr Marc Hamy, Director of Air Navigation Services, France, visited Headquarters. He was briefed on the Single European Sky implementation, SESAR and DMEAN. The briefing was concluded with a visit to the CFMU operations room.

On 3 February, the Director of the General Secretariat, Dr Gerhard Stadler, welcomed Dr Dieter-Lebrecht Koch, Member of the European Parliament. Dr Koch and his delegation were briefed on the main activities of the Agency, focusing on international relations and safety and security. The visit was concluded with a presentation on the CFMU.

On 30 January, the Director of Air Traffic Management Strategies, Mr Bo Redeborn, welcomed a delegation from the U.S. Government Accountability Office. Discussions were held on the Single European Sky ATM Research (SESAR) Programme, financial and legal aspects of the Central Route Charges Office and the Performance Review Commission.

On 25 January, the Director of the General Secretariat, Dr Gerhard Stadler, welcomed the U.S. Senate Appropriations Committee. Areas of discussion included the Central Route Charges Office and the Performance Review Commission.

On 23 January, a delegation from the Japanese Civil Aviation Bureau visited EUROCONTROL. Discussions were held on the Overall ATM/CNS Target Architecture (OATA), the European Convergence and Implementation Plan (ECIP), Navigation, Mode S and Communication and Surveillance, including ARTAS. The visit was concluded with a tour of the CFMU operations room.

On 6 January, Mr Tomás Bittar, President of the National Aviation Administration of Paraguay (DINAC) visited EUROCONTROL in order to establish closer relations with the Agency. The President was accompanied by Mr Jesús César Ríos, Deputy Director Air Transport and International Affairs, DINAC; Mrs María Liz Vivero de Bazán, Air Transport Manager, DINAC; and Mrs Inés Martínez Valinotti, First Secretary, Mission of Paraguay to the EU.
On 25 January, Massimo Fusco, Director of the Central Route Charges Office, and Istvan Mudra, CEO of HungaroControl, signed a bilateral Agreement whereby the Hungarian air navigation service provider entrusted EUROCONTROL with the calculation, billing, accounting and collection on its behalf of charges for terminal air navigation services.

In February 2006, the EUROCONTROL Agency established initial contacts with the Belarusian civil aviation authorities and the country’s air navigation service provider, Belaeronavigatsia. Belarus is situated in a part of Europe where high traffic volumes are expected. Different ways for further strengthening the cooperation between EUROCONTROL and Belarus, which is not yet a Member of the European Civil Aviation Conference, were discussed.

Photo: (left) Dr Gerhard Stadler, Director of the EUROCONTROL General Secretariat, meets Mr Vadim Melnik, Chairman of the State Aviation Committee of the Republic of Belarus

Skyway would like to wish Pierre-Olivier Jeannet good luck on his new adventure when he retires at the end of March after an exceptional thirty-three-year career in EUROCONTROL’s Central Flow Management Unit (CFMU).

A graduate from two prestigious French “grandes écoles”, the Polytechnique and ENAC, Pierre-Olivier Jeannet worked for the French civil service before joining EUROCONTROL in 1973 as an expert.

He will always be remembered for his exemplary contribution towards the creation of the CFMU. In 1989, he was appointed as Project Manager and soon after took on the role of Head of Division when the Data Bank EUROCONTROL became the CFMU Directorate.

This was at a time when Europe was suffering from significant traffic delays. The International Civil Aviation Organization and EUROCONTROL devised a plan to address the situation, known as the Central Traffic Flow Management Organisation (CTMO) concept.

It was Pierre-Olivier Jeannet, under the then EUROCONTROL Director General Keith Mack, who worked in a pragmatic and focused way to carry out this revolutionary pan-European project. To accomplish his mission, Jeannet needed a really good team and he worked with various people, including Peter Schmutz, Brian Martin, Alex Vink, Jürgen Blume, Claude Leclerc and Gérard Lambert. Together they produced a full report in six weeks – the famous CFMU’s Implementation Plan, better known as the “Bouquin Blanc”. The plan contained the entire set of blue prints for what would finally become the CFMU.

The Data Bank EUROCONTROL began to develop the necessary systems and worked out ways of providing new operational services. We all know the outcome of this formidable work – CFMU tactical operations began in April 1995 and a year later, the CFMU went into full operation, providing the European ATM community with centralised air traffic flow management services.

Today the CFMU continues to evolve – adapting its services and introducing new functions and operations in order to meet the constantly changing demands of the ATM environment.

Pierre-Olivier Jeannet has made a phenomenal contribution to this Agency. He has worked hard and with devotion. Skyway wishes him all the best on his new journey!

Farewell to Pierre-Olivier Jeannet!
Head of the CFMU Engineering Division