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Final Study

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Options Brief

Introduction

Civil aviation is a complex system: carriers, air traffic control providers, air traffic control management, the manufacturing industry, maintenance shops, national aviation authorities, international organisations and airports have to work in a closely coordinated manner to ensure a safe, timely and cost-efficient aviation system.

Military aviation has also various difficulties since it operates a wide range of aircraft types, from large transport aircraft, through high-level and low-level ground-attack, fighter and training aircraft, to helicopters and unmanned aerial vehicles. These aircraft are required to operate in all airspace environments and have special airspace requirements in addition to general airspace use (e.g. low-level flying, in-flight refuelling and air-to-air combat training).

The character of Air Traffic Control (ATC) planning in the European region is significantly affected by three important factors: its vast geographical size, its diversity and the multiplicity of intergovernmental organisations involved in aspects of planning on a less than full regional basis.

The collection of data and opinions from various sources aims to obtain a clear picture of the situation in those organisations, which are today involved in ATC over Europe. The information collected will also hopefully show the difficulties concerning the changes, which are necessary for better functionality and more effectiveness in the area of Air Traffic Management (ATM), including the transition period. The role of airspace management is to allocate that resource to users so that each of them gets a reasonable share, allowing them to fulfil their tasks and to prosper. The erratic growth in air transport has already led to severe problems of overcrowded airports, overloaded Air Traffic Control Systems (ATCS), delays and, finally, deterioration of service offered to air passengers.

CNS/ATM (Communications, Navigation, Surveillance / Air Traffic Management) describes the technical concepts as well as the implementation of the infrastructure necessary for the provision of air navigation services. This also covers future concepts such as digital Data Links for transmission of operational data, the Automatic Dependent Surveillance (ADS) concept and satellite-based navigation, the Global Navigation Satellite System (GNSS). New CNS equipment that uses space-based navigation (GNSS) and space-based communication (SATCOM) enables the consistent and potentially seamless operation of aircraft throughout the world. In conjunction with a global communication network, the system can provide capability for the air traffic control, airline operations and passenger services, in order to meet the ATM goals.

The Future-oriented Air Navigation System (FANS) is the single, most complex and far-reaching initiative ever undertaken in the history of civil aviation. The world aviation community has the moral responsibility to do all that is humanly possible to ensure the safety and efficient development of international civil aviation.

The credibility of the reorganisation of ATM in Europe depends on the involvement of military authorities in the definition and implementation of the regulatory framework, which needs predictability, clarity, and transparency for the benefit of all users. This effort would allow the implementation of a more integrated management of the airspace, without the limitations of

national borders, in order to maximise capacity through initiatives such as "Flexible Use of Airspace", a harmonisation of airspace categories and free routing, starting with upper airspace above a certain altitude and continuing in stages to optimise capacity. The term "flexible" involves the separation of civil and military ATM systems and controlling procedures, depending on special or ordinary circumstances.

Options

a.) A new Organisation should be established as part of the Community system. It should be entitled to build on its expertise and carry out preparatory work in all areas covered by the Regulation establishing it; it might, therefore, develop international cooperation and research activities as appropriate. In all these fields the Organisation should be entitled to formulate recommendations or opinions.

b.) The introduction of performance-incentive pricing certainly entails economic regulation, and airspace and standards regulation are also needed to ensure that a single system is developed for Europe. This points the way to a further development, which is the establishment of a single Community regulatory framework.

c.) Europe needs harmonised, well-managed Air Traffic Services that operate as a single entity. A comprehensive, gate-to-gate ATM Strategy to provide a framework for future growth is called for; one to follow up on the ECAC En-Route Strategy (which led to the creation of EATCHIP), as well as the Airport Strategy. It is envisaged in the ATM Strategy for the year 2000+.

As airlines obtain substantial savings in both fuel and time, the result will be greater levels of safety, capacity and efficiency to support the anticipated growth of the air transportation system for many years. This global effort should pay great dividends to all concerned - airline operators, Air Traffic Control Centres (ATCCs) and the travelling public.

d.) The concept of the separation of service provision and regulation in ATM must be examined by every State separately. However, the applicability of the concept cannot be confined solely to the national level. Therefore at this point there is a very wide area for development under the contribution of international organizations such as Eurocontrol, Joint Aviation Authorities (JAA), the proposed European Aviation Safety Agency (EASA) and any new Organization to be established.

It is essential to recognise that European States show different rates of progress in the movement towards a more market-orientated ATM system. Significant change to Eurocontrol can only be achieved using a stepped, evolutionary approach. It is vital for the EC citizens and the reliability of the European authorities that this change should begin now and no more time should be lost.

e.) JAA will continue its work with the aim of becoming the core of a new European Aviation Safety Authority, or a powerful organisation that will set the aviation community on a successful course in all areas that will be subject to considerable changes in coming years.

Conclusions

Several benefits can be identified which may be derived from the implementation of the above-mentioned changes and the CNS/ATM elements. The functions and systems needed to obtain these benefits are available or already in use in different parts of the world. The benefits are primarily economical, but functions and elements enabling the benefits often also increase aviation safety. This should be seen as a further benefit even if it cannot be costed, i.e. – no budget figures available. The benefits can be grouped into five categories:

- 1) enhancement of safety,
- 2) improvement of economy of flight,
- 3) reduction of delays,
- 4) increase in airspace capacity, and
- 5) improvement of controller productivity.

Executive Summary

Introduction

Civil aviation is a complex system: Carriers, air traffic control providers, air traffic control management, the manufacturing industry, maintenance shops, national aviation authorities, international organisations and airports have to work in a closely co-ordinated manner to ensure a safe, timely and cost-efficient aviation system.

The character of Air Traffic Control (ATC) planning in the European region is significantly affected by three important factors: its vast geographical size, its diversity and the multiplicity of intergovernmental organisations involved in aspects of planning on a less than full regional basis.

The history of aeronautical development shows that there is an intimate relationship between civil and military aeronautics. One of the domains with tremendous potential for amelioration is ATC. One of the geographical areas with huge potential is the European Union (EU).

Aviation has shown by far the most rapid growth of all forms of transport within the last twenty years in the EU. Traffic has risen by 7.4% - on average - a year since 1980, in terms of passengers per kilometre. Air traffic through the airports of the Fifteen has risen fivefold since 1970.

Air Traffic Control and its difficulties

The role of airspace management is to allocate that resource to users so that each of them gets a reasonable share, allowing them to fulfil their tasks and to prosper. The Kosovo crisis has shown once more that the current arrangements cannot cope with crises and any other difficulties in general. The erratic growth in air transport has already lead to severe problems of overcrowded airports, overloaded Air Traffic Control Systems (ATCS), delays and, finally, deterioration of service offered to air passengers.

According to the European Council resolution of 19 July 1999 on the situation of air traffic delays in Europe, the single European market requires a properly functioning air transport system to ensure the mobility of the citizens. This mobility is necessary in the interest of the economic competitiveness of the European Community. A reliable and efficient air transport system contributes to the wealth of the European Community and its citizens.

Future aspects in air transport through various ATC international programmes

Some aspects of ATC implementation planning, is now largely achieved through regional organisations such as the European Civil Aviation Conference (ECAC) and Eurocontrol, e.g. through the harmonisation and integration programme, EATCHIP, which embraces most of the ICAO Contracting States located on the western part of the European Region. In the eastern part of the European Region, especially that of the new Contracting States, ICAO, through the Eurocontrol Air Traffic Management (ATM) programme (EANPG), will continue its full-scale regional involvement to help States in discharging their related responsibilities. ICAO and the EANPG retain the responsibility to ensure conformity of such initiatives with the Regional Air Navigation Plan (RANP) of the entire region.

Aviation safety

Aviation safety is the fundamental guideline for all the aviation authorities, as well as for the European Commission, the European Council and the Parliament, which can influence the growth of the aviation industry. Air transport will remain the safest mode of transportation in years to come. Ensuring this requires that two fundamental conditions be met:

- The first is the consistent worldwide application of ICAO Standards and Recommended Practices (SARPs) because the level of safety in aviation is and will always be directly related to the level of implementation of these standards.
- The world-wide implementation of CNS/ATM systems, which involves the integration of satellite and computer technologies with Communications, Navigation, Surveillance and Air Traffic Management, is a second essential condition for the safe and orderly growth of civil aviation in the 21st century.

Aviation safety and new technology

Implementing the primarily satellite-based CNS/ATM systems will make it possible to increase the number of aircraft that can fly safely and efficiently in a given airspace. The objective of the world aviation community is nothing less than a system which provides aircraft operators with the freedom to choose a preferred flight plan with minimum constraints, while maintaining or increasing existing levels of safety.

The "Future-oriented Air Navigation System" (FANS) is the single, most complex and far-reaching initiative ever undertaken in the history of civil aviation. The world aviation community has the moral responsibility to do all that is humanly possible to ensure the safety and efficient development of international civil aviation. Everyone must truly believe that all parts are fully committed to aviation safety and to a harmonised global air transport system.

Air traffic delays

Delays have financial and economic consequences for airlines, for their clients and for the community. The airlines bear additional costs on fleet, as well as flying and ground personnel, since delays prevent them from operating in optimum conditions. They must also compensate passengers for their discomfort experienced and to avoid prejudice. Also, according to their type of operations, airlines might experience specific costs (i.e. linked to hub operations).

EU decisions and regulations concerning aviation industry

Since 1989 the European Council and the European Ministers of Transport have decided to formalise the active involvement of all Member States within Eurocontrol, as a manifestation of their will to solve ATM problems (*Council Resolution 89/C 189/02 of 18 July 1989*).

On 16 July 1998 the European Council adopted a decision authorising the Commission to open negotiations with European Community Member States, with a view to concluding an

agreement establishing a European Aviation Safety Agency (EASA), which will have the legal form of an international organisation.

Civil/Military Co-operation

Effective air traffic management is inconceivable without close association of civil and military components. It is time to bring together civil and military expertise and requirements at European level in co-operation with NATO. Civil and military airspace requirements over the territory of the 16 NATO nations should be fully co-ordinated. This includes the implementation of major air exercises, the harmonisation of air traffic control systems and procedures and the sharing of communications frequencies.

This effort would allow a more integrated management of the airspace, without the limitations of national borders, in order to maximise capacity through initiatives such as Flexible Use of Airspace, harmonisation of airspace categories and free routing, starting with upper airspace above a certain altitude and continuing in stages to optimise capacity.

Flexible Use of Airspace

The concept "Flexible Use of Airspace" has been quite often used by all parties involved and by quite different specialists in the ATM issue. The term "flexible" signifies the separation of civil and military air traffic management systems and controlling procedures, depending on special or ordinary circumstances.

Civil and military authorities have to and will co-operate very closely, openly and frankly with each other. Suspicion is not the rule in this case; it is however a barrier that to some extent still exists and will have to be absolutely eliminated – or in practice will have to be treated in the politically-correct way of mutual understanding.

Eurocontrol and its role

The aviation community and the trade union at Eurocontrol in Maastricht maintain that there should be:

- no more boundaries in pan-European airspace, but still taking account of national necessities
- a substantial reduction in the number of civil and military ATC centres
- more flexible use of airspace, normally with preference given to civil operations in peacetime
- a fast, integrated approach to technical innovation, optimisation, recruitment, training and licensing of Air Traffic Control Officers (ATCOs)
- compatible ATC systems, languages and technical facilities
- Reduced Vertical Separation Minimum (RVSM) without any derogation
- Area Navigation (RNAV) in common use
- a mandatory satellite system
- a European Enhancement Plan involving all stakeholders which responds to the needs of users
- a strong, "no-blame" safety culture.

Changes are foreseen in the European institutional set-up under which Eurocontrol would be called upon to take on progressively the policy role that ECAC has performed until now. In

order to increase the welfare of European citizens, the Community must alleviate airspace congestion and reduce air traffic delays that are becoming increasingly serious.

The European Commission has established a High-Level Group to assist it in developing an action plan for the creation of a single European sky. Industry members were invited to a "shadow" group by the Commission to represent the industry's interests and stimulate the debate in parallel with the activities of the High Level Group. The Commission hopes to engender synergy between the groups so as to ensure a common approach.

Joint Aviation Authorities (JAA) and the necessity of reform

In preparing itself for the development into a future European Organization, the JAA developed the Agenda for Change and this is now being implemented step by step in the JAA system. Together with the Agenda for Change, the NPA for JAR 11 has been issued and the comment period ended on 31 May 2000.

JAA will continue its work with the aim of becoming the core of a new European Aviation Safety Agency, or a powerful organisation that will lead the aviation community to a successful course in all the areas that will be under considerable changes in the following years.

Evolution of EASA

The Commission proposal COM(2000)144 (Brussels, 21/3/2000) for the creation of a European Aviation Safety Agency (EASA) is very important for the continuous growth of air transportation. According to the specialists interviewed during the realisation of this project, the need for one, powerful Organisation for air traffic regulation within the EU of present and future boundaries is unanimously acknowledged.

Aviation Regulation

The Organisation should be established as part of the Community system. It should be entitled to build on its expertise and carry out preparatory work in all areas covered by the Regulation establishing it; it might, therefore, develop international co-operation and research activities as appropriate. In all these fields the Organisation should be entitled to formulate recommendations or opinions. More precisely:

- It should develop essential requirements and implementing rules applicable to aeronautical products, personnel and organisations and forward them to the Commission.
- It should develop and adopt acceptable means of compliance and guidance material, including airworthiness codes, for the application of the above rules.

Air Traffic Regulation

The current institutional arrangements in Eurocontrol are structured on its inter-governmental role and are increasingly based on the assumption that ATM is a politically controlled function. The time has come to begin the expansion of Eurocontrol from an inter-governmental body, which has the responsibility of Central Air Flow Management Service (CAFMS), to a centre for ATM training and ATC research, with a view to creating four or five more centres for air flow management in Europe. The existing regulatory bodies of the Performance Review Commission (PRC) and the Safety Regulation Commission (SRC),

together with JAA, could join forces and work under the umbrella of a new European Aviation Organisation with a regulatory function, but having also research activities.

It is essential to recognise that European States show different rates of progress in the movement towards a more market-orientated ATM system. Significant change to Eurocontrol can only be achieved using a stepped, evolutionary approach. It is vital for EC citizens and for their trust in European authorities that this change should begin now and no more time should be lost.

CAAs' proposals on new regulations

Civil Aviation Authorities (CAAs) provide Air Navigation Services (ANS) in all States of the EU. The CAAs provide their operational services by themselves or via their wholly-owned subsidiary ATMP. The provision of the ANS via ATMP should be the subject of an agreement between ATMPs and the governments concerned for defence matters, which would enable the joint and integrated provision of the civil ANS and the military ANS. Access to airspace should be provided on an equitable basis without discriminating against any particular class of users. Airspace users, whether military, commercial or individual leisure flyers, will want this to remain the case.

A Safety Regulation Group (SRG) whose role is to ensure that high safety standards must be set up for European civil aviation. SRG has to be satisfied that aircraft are properly designed, manufactured, operated and maintained; that airlines are competent; that flight crews, air traffic controllers and aircraft maintenance engineers are fit and competent; that licensed aerodromes are safe to use, and that air traffic services and general aviation activities meet required safety standards.

Certification procedures

This new Community system will not work in isolation from other pan-European organisations such as ECAC or Eurocontrol, or from other international organisations involved in the field covered by this Regulation, such as ICAO. Its work and activities will be interdependent with those carried out by such organisations and should actually combine them all. The Organisation should be entitled to undertake the necessary steps for early and close involvement of, and co-operation among them.

Future aspects of ATM

A system which transfers risks, costs and rewards to the service provider is needed to provide the incentive for itself to improve performance in terms of service value and safety. The most important advantage of separating the responsibility for ATM service provision from the civil aviation services of States is the opportunity it affords to separate service provision from regulation which, typically, can remain a state function.

The introduction of performance-incentive pricing certainly entails economic regulation, and airspace and standards regulation are also needed to ensure that a single system is developed for Europe. This points the way to a further development, which is the establishment of a single Community regulatory framework.

CNS/ATM new concept

CNS/ATM (Communications, Navigation, Surveillance / Air Traffic Management) describes the technical concepts as well as the implementation of the infrastructure necessary for the provision of air navigation services. This also covers future concepts such as digital Data Links for transmission of operational data, the Automatic Dependent Surveillance (ADS) concept and satellite-based navigation, the Global Navigation Satellite System (GNSS).

When the ICAO FANS Committee addressed the technical shortcomings of the tools then currently used in the provision of air traffic services, potential technical solutions were initially proposed in regard to CNS elements. However, it was apparent that it was necessary to put these tools into an operational context, and develop operational concepts for their use in the management of air traffic. The ATM element was subsequently added to the total CNS/ATM concept.

The introduction of new CNS capabilities and increasingly capable ground and airborne systems will enable the evolution of more sophisticated ATM systems. Air traffic control facilities providing Data Link-based ATM must be capable of receiving, storing, processing, displaying and disseminating specific flight information relating to flights equipped for and operating within environments where a Data Link service is provided.

A fully-integrated ATM system will make increasing use of automation to reduce or eliminate a variety of constraints imposed on ATM operations by current systems. ATM encompasses all of the elements traditionally associated with ATS and also several additional elements of the overall air navigation infrastructure. It can be implemented in virtually any or all phases of the operation, airport through 'en-route', and will provide significant gate-to-gate benefits.

FANS (Future Oriented Air Navigation Systems)

The future Air Navigation System (FANS) committee's plan for Communication-Navigation-Surveillance (CNS) and Air Traffic Management (ATM) has launched the next generation of airspace management. By using advanced computing capability in the air and on the ground, new levels of efficiency, capacity and safety are possible. While the changes are revolutionary, the process of change is evolutionary.

Air Traffic Control Systems at Airports

Controllers, pilots and vehicle drivers will be assisted by different decision support tools, which will provide:

- an improved traffic situation awareness;
- automatic detection of runway incursions and conflicts in between taxiing aircraft;
- an improved aircraft guidance on the movement area;
- an improved planning of aircraft ground movements to allow for the most efficient use of runway(s) capacity.

Navigation improvements

To achieve the full benefit of FANS, air traffic control procedures will need to change and the separation distances between aircraft will need to be reduced. Ultimately, airlines hope to gain total freedom for pilots to select their routes and to change these routes in flight,

safely and efficiently. This goal, known as “Free Flight”, will ensure that the most economic, the fastest or most direct route will be flown, according to the requirements of each individual flight.

As airlines obtain substantial savings in both fuel and time, the vision of the FANS committee will spread quickly. The result: greater levels of safety, capacity and efficiency to support the anticipated growth of the air transportation system for many years. This global effort should pay great dividends to all concerned - airline operators, Air Traffic Control Centres (ATCCs) and the travelling public.

Technical solutions and benefits

To achieve the economic benefits of a modern air transportation system, CNS/ATM is an integration of advanced, global communication, navigation and surveillance functions with a modern, efficient air traffic management system. This requires an advanced capability on the aeroplane, which can work in harmony with the upgraded ATCCs. When will benefits materialise? Timing is dictated by the availability of avionics, communication infrastructure and upgrades to ATCCs. Eurocontrol, ECAC and JAA must keep working with member States to explain and refine the CNS/ATM concept, the benefits of installing new technology and the economic necessity of a modern air transportation system.

Aspects for Consideration

Considerable attention to the airborne equipment, which must be prepared, is also necessary. The “heart” of CNS/ATM, the Flight Management System (FMS) provides the basic integration of navigation, communication and surveillance functions, as well as the primary pilot interface. Other key elements include Satellite Communication (SATCOM), GNSS, display systems and Communication Management Units (CMUs). In the overall system design, human factors play a key role in certification and growth potential as the interface between ground ATCCs and the aeroplane becomes more complex.

FOREWORD

This Final Study on "Civilian and Military Air Traffic Control in the EU" presents, on the one side, a factual assessment of Air Traffic Control (ATC) performance in the European Civil Aviation Conference (ECAC) area and, on the other side, introduces a strong, transparent and independent performance review and target setting system of regulations and technical aspects to facilitate more effective management of the European Air Traffic Management (ATM) system.

In Europe, civil air transport generates in the order of € 70,000 million of annual revenue and provides 500,000 jobs. Civil and military airspace users, air passengers, freight shippers, and the community at large rely heavily on ATM, whose mission is to ensure the safe, regular, efficient and economical operation of air services. It is logical to talk more about ATM as a system and not about ATC specifically, except where it is necessary to give concrete information about ATC.

European Air Traffic Services (ATS) and airports are strongly independent and form a network whose performance is very much influenced by that of its weakest links. Other stakeholders, such as aviation authorities, airspace users and the Eurocontrol agency, also have a strong influence on ATM performance in Europe. As far as air traffic is concerned, interdependence with other parts of the world is limited, since only 8% of aircraft flying in Europe depart or land outside Europe. Therefore, when considering several aspects of ATM performance, one should take a Europe-wide view.

Civil aviation is a complex system: Carriers, air traffic control providers, air traffic control management, the manufacturing industry, maintenance shops, national aviation authorities, international organisations and airports have to work in a closely-coordinated manner to ensure a safe, timely and cost-efficient aviation system.

The character of ATC planning in the European region is significantly affected by three important factors: its vast geographical size, its diversity and the multiplicity of intergovernmental organizations involved in aspects of planning on a less than full regional basis.

The European region comprises a continental area extending from the North Atlantic region in the West to the Pacific Ocean and the Asia/Pacific region in the East. The ATC future plan for the European region has to be applied to no fewer than 50 European States. More than 20 of these States emerged only in the past decade from the former Czechoslovakia, USSR and Yugoslavia. With different needs, they render the region far less than a homogeneous whole.

The diversity of the region extends far beyond that of the States in it. There are wide variations in air traffic densities and the states of development of national ATC systems. Finally, the number of intergovernmental organisations and the degree of their involvement, with less than full regional scopes of activity in matters affecting ATC, create complexities not experienced in most other regions of the world.

The history of aeronautical development shows that there is an intimate relationship between civil and military aeronautics. One of the domains with tremendous world-wide potential for amelioration is ATC. One of the geographical areas with huge potential is

the European Union (EU). However, as far as technical issues are concerned, it is very difficult to speak about the development of the aviation industry only within the EU, because history has shown that the development of aviation is a world-wide phenomenon. As a result, one cannot put any geographical area of the world aside.

The collection of data and opinions from various sources aims to provide a clear picture of the situation in the organisations, which are today involved in ATC over Europe. The collected information will also hopefully manifest the difficulties concerning the changes, which are necessary for better functionality and more effectiveness in the area of ATM including the transition period. The possible options and scenarios, including all the parameters of the necessary changes, might also contribute to the idea of a new concept to be applied by all the interested sites.

When one looks closely at various areas of the world where traffic is likely to increase, one finds estimations that in the transatlantic, North America-Pacific, intra-Pacific, and Europe-Pacific regions traffic is going to swell by three to six per cent on an annual basis. Growth in the next 12 years will be larger than all the traffic we have generated from the start of commercial service until the present time. This magnitude of increase is potentially the driving force for the development of higher-speed transports and the adoption of new technology.

All the above-mentioned prospects require appropriate infrastructure and air space capacity to be provided in a coordinated and consistent way. The air space users should contribute to the efficient use of the air space capacity in the EU. The European Commission (EC) has established a High-Level Group to assist it in developing an action plan for the creation of a single European sky.

Before starting to examine all possible solutions for providing a single way to improve the situation for the aviation community in Europe we must examine the situation carefully, in regard to the growth and liberalisation of air transport, ATM and aviation safety. In these sections we shall try also to give an account of the role of military aviation and, of course, the problem of delays in Europe.

PART A - OPTIONS

Introduction

Present situation and forecasts of air transport

1. Air transport in the European Community has been progressively liberalised since 1988 and the Community market in this sector has evolved from a market based on bilateral agreements, with virtually no competition, towards a genuinely open market based on the principles of the Treaty. In many -not only in some- parts of the European civil aviation system, we are acting at the limits of capacity, even beyond. And civil aviation is, after telecommunications, the sector of the economy that continues to have the highest growth rates in Europe. Air transport is governed by common rules, which address licensing, market access, pricing and application of competition rules. Airlines and consumers have greatly benefited from this situation, which has led to job opportunities and the entry of new operators into the market.
2. Total scheduled passenger traffic of the world's airlines has grown at nearly 6% in 2000, is expected to grow by 5.5% in 2001 and still by over 5% in 2002, according to forecasts recently published by the International Civil Aviation Organisation (ICAO). Total international and domestic scheduled passenger traffic generated by the airlines of the 185 ICAO Contracting States is estimated at 2,791 billion passenger-kilometres for 1999. This is expected to rise to about 2,956 billion in 2000, 3,118 billion in 2001 and 3,284 billion in 2002. We have to admit, that until now figures predicted for civil aviation have always become reality even sooner than foreseen. Having experienced a doubling in air transport within a remarkably short period of time a further doubling will have to be considered in terms of its impact on the environment of infrastructure constraints and of limits to the capacity increases. For the politicians another doubling is an unrealistic scenario.

The attached table summarises the ICAO medium-term forecasts for the airlines of six regions and for the world as a whole.

ICAO scheduled passenger traffic forecast
(passenger-kilometres performed, 2000-2002)

Region of airline registration	ACTUAL			ESTIMATED				FORECAST			
	1988 billions	1998 billions	Average annual growth (%)	1999 billions	Growth (%)	2000 billions	Growth (%)	2001 billions	Growth (%)	2002 billions	Growth (%)
Africa	38.1	55.7	3.9	61.7	10.8	65.1	5.5	68.9	5.8	72.8	5.7
Asia/Pacific	309.2	622.7	7.3	665.5	6.9	712.1	7.0	764.8	7.4	819.8	7.2
Europe	508.2	692.6	3.1	743.0	7.3	793.5	6.8	838.8	5.7	884.0	5.4
Middle East	45.6	78.4	5.6	79.1	0.9	83.1	5.0	86.8	4.5	90.8	4.6
North America	725.8	1 042.3	3.7	1 104.9	6.0	1 159.0	4.9	1 206.6	4.1	1 254.8	4.0
Latin America/ Caribbean	78.7	136.0	5.6	136.8	0.6	143.6	5.0	152.1	5.9	162.2	6.6
World	1 705.6	2 627.7	4.4	2 791.0	6.2	2 956.4	5.9	3 117.9	5.5	3 284.4	5.3

3. By the end of the 1980's, there were about 7,000 commercial transport companies in the world flying about 870 billion revenue passenger miles per year. The expectation at that time for the year 2025 was that there would be an increase by more than a factor of four

in passenger miles. The prediction was that there would be 16,000 transport companies producing close to 4,000 billion passenger miles. If we consider today the data quoted in the previous paragraph, we see that this expectation will be reached much earlier than expected and there will be extensive expansion of commercial aeroplane travel on a world-wide basis, especially in Europe and the Pacific region.

4. Aviation has shown by far the most rapid growth of all forms of transport within the last twenty years in the EU. Traffic has risen - on the average - by 7.4% a year since 1980, in terms of passengers served. Air traffic through the airports of the Fifteen has risen fivefold since 1970. But the growth of civil aviation has limits set by the capacity, on the one hand, of airports and, on the other hand, of air traffic control management. While it might not be welcomed by many interested parties, it looks as though a realistic scenario for European civil aviation in the year 2010 cannot be based on unlimited growth, according to the data on aircraft speed and size, airports, airspace volume etc., which are available today.

The complexity of the aviation system

5. Airports are perhaps the most complex sub-system of the civil aviation system as such. And airports might be part of the industry we know least. The persons responsible for ATC are often accused of being accountable for the majority of the delays of flights. Databases tell us that the percentage of delays caused by air traffic control is about one third of the delays. But there are no reliable hard data, as to how many delays are caused by the airports and individual components of airports. Therefore not only airline managers but also politicians might under-estimate the importance of airports for civil aviation as a whole.
6. Air traffic is composed mainly of the military Operational Air Traffic (OAT) and the General Air Traffic (GAT). Although the military air traffic is less than 5%, OAT requires large volumes of airspace where military aircraft can train for interception, bombing, etc. GAT encompasses all other movements, generally of aircraft flying from one point to another, which need protected corridors. GAT also includes some other kinds of flights like leisure, training, aerial work, aircraft testing, whose needs are similar to those of OAT. All these types of air traffic compete for the same scarce resource: Airspace.
7. The role of airspace management is to allocate that resource to users so that each of them gets a reasonable share, allowing each user to fulfil his tasks and to prosper. The Kosovo crisis has shown once more that the current arrangements cannot cope with crises. The erratic growth in air transport has already led to severe problems of overcrowded airports, overloaded Air Traffic Control Systems (ATCS), delays and, finally, deterioration of service offered to air passengers.
8. Air traffic problems over Europe are well known to the authorities and the professionals who are involved in aviation business. Congestion is a very frequent phenomenon in the airspace of central Europe, caused by flight delays, which affect most of the big airports. However, these airports are part of a network that supports air transportation across Europe. These delays come to be added to the delays due to other reasons, like technical problems on aircraft equipment at the last moment before take off, other technical problems on ground equipment for landing (ILS, MLS), strikes of airports' personnel, bad weather conditions etc.

9. According to the European Council resolution of 19 July 1999 on the situation of air traffic delays in Europe, the single European market requires a properly functioning air transport system to ensure the mobility of the citizens. This mobility is necessary in the interest of the economic competitiveness of the European Community. A reliable and efficient air transport system contributes to the wealth of the European Community and its citizens.

Future aspects in air transport through various international ATC programmes

10. To alleviate serious capacity problems that emerged during the late 1980s, the EU Member States together with the European Commission, adopted stringent measures to harmonise air traffic services and jointly planned air traffic management within their respective areas of responsibility. Subsequently, the Ministers of Transport of the ECAC States endorsed the European Air Traffic Control Harmonisation and Integration Program (EATCHIP) developed by ECAC, and gave Eurocontrol a mandate to manage its implementation. This included the commitment to implement the Central Flow Management Unit (CFMU) of the Centralised Air Traffic Flow Management Organisation (CTMO) concept, stipulated in the ICAO Air Navigation Plan for the European Region (EUR ANP). As a complement to EATCHIP, ECAC also established an Airport/Air Traffic System Interface (APATSI) programme to carry out aerodrome operations planning, particularly airport/ATC capacity aspects. ECAC also promoted the creation of the Joint Aviation Authorities (JAA) to deal mainly with airworthiness and the safety of air operations.
11. Some aspects of ATC implementation planning are now largely achieved through regional organisations such as ECAC and Eurocontrol, e.g. through the harmonisation and integration programme, EATCHIP, which embraces most of the ICAO Contracting States located on the Western part of the European Region. In the Eastern part of the European Region, especially that of the new Contracting States, ICAO, through the Eurocontrol ATM programme (EANPG), will continue its full-scale regional involvement to help States in discharging their related responsibilities.
12. Now, along with EANPG, ICAO takes into account what groups of States, or agencies (ECAC, Eurocontrol, JAA and others) acting on their behalf, do within the European Region in the fields of air traffic services harmonisation, flow management, and aerodrome operations planning. At the same time, ICAO continues to provide a forum for all States in the region for regional air navigation planning and to resolve contentious issues, issues of interface between sub-regions, or interface with other regions, of non-technical matters impacting on international civil aviation, and of contingencies and crises. EANPG constitutes a mediating element and will continue to function as a catalyst for widely-acceptable solutions.
13. In summary, collective air navigation planning and implementation initiatives undertaken by State groupings, irrespective of their constitutional nature (regional organisations, State associations and others), have proven efficient in harmonising air traffic services and air traffic flow management, as well as aerodrome operations planning. ICAO and EANPG retain the responsibility to ensure conformity of such initiatives with the Regional Air Navigation Plan (RANP) of the entire region.

14. There are three main priorities of modern Air Traffic Management: Normal Flowing, Quick and Safe. As air traffic grows, all three aspects are to be checked even more carefully. European airspace is often described by different parties involved as rather saturated and inefficiently controlled, coming close to the limits of today's control procedures. Some of Europe's airports are already close to their capacity limits. All these signs of saturation lead to limitations of usage by new carriers that could - under other infrastructure conditions - contribute to the settlement of some inefficiencies and avoidance of many delays.

15. To alleviate airspace congestion and reduce air traffic delays, which were becoming increasingly serious, the year 1999 was devoted to reviewing the effectiveness of several programmes and the impact they have had on the performance of the ATM System. Findings brought to light a contrasted picture in the sense that, whereas significant traffic increases had been accommodated while maintaining high safety levels and avoiding escalation in user charges, punctuality deteriorated, triggering acute disappointment from airspace users. It emerged that new pan-European initiatives were called for to tackle urgently the short-term and to guide medium and long-term developments:
 - the commitment to full implementation of the outstanding actions in the "ECAC En-Route Strategy for the 1990's" for the harmonisation and integration of Europe's ATC systems, so as to create additional capacity in the shortest timescale;
 - the endorsement of the overall performance target set for the year 2000 (handling at least a 5.3% increase over the 1999 level and decreasing the average delay per flight in the summer to the level observed in summer 1997) together with associated plans and actions to achieve it;
 - the request for improvements to the Air Traffic Flow Management (ATFM) process in order to optimise the use of existing capacity to appropriately adjusted demand, and for the national stakeholders to adhere closely to agreed targets and plans;
 - a seamless European ATM system;
 - the request to Eurocontrol, in co-operation with the European Community, to establish a proper mechanism to reinforce implementation by all the parties involved of the collective decisions taken through Eurocontrol;
 - a discussion of challenges posed by the ever-increasing air traffic demand and the political consequences of attempting to eliminate completely the present imbalance between capacity and demand;
 - an initiative in regard to safety, which remains the first and foremost priority, to cost, financing and other practical matters – in the light of continuous increases in capacity in line with air traffic demand.

Aviation safety

Introduction

1. Aviation safety is the fundamental guideline for all Aviation Authorities, as well as for the European Commission, the European Council and the Parliament, influencing the growth of the aviation industry.

2. Air transport will remain the safest mode of transportation in years to come. Essential conditions for the safe and orderly growth of civil aviation in the 21st century are:

- the consistent world-wide application of ICAO SARPs (Standards and Recommended Practices) because the level of safety in aviation is and will always be directly related to the level of implementation of these standards.
 - the world-wide implementation of Communication-Navigation-Surveillance/Air Traffic Management (CNS/ATM) systems, which involves integration of satellite and computer technologies with Communications, Navigation, Surveillance and Air Traffic Management.
3. “Strict adherence to international civil aviation regulations and modernisation of global air navigation systems is necessary to maintain this high degree of Aviation Safety throughout the 21st century”, says Dr. Assad Kotaite, President of the Council of ICAO. The umbrella for all safety-related activities of the Organisation is the ICAO Global Aviation Safety Plan (GASP), which focuses on those current or planned initiatives judged most effective in reducing the accident rate.
 4. Technology development and sharp but fair regulation have to respond to increasing public awareness of air transport accidents, especially those related to high-capacity aircraft. Advanced automation and increasing technological integration between ground/airborne systems will add new and better aspects to safety.
 5. Although many Contracting States first meet and afterwards surpass the ICAO standards, others do not, primarily due to the lack of adequate resources, expertise or proper civil aviation infrastructure. ICAO’s Technical Co-operation Program provides the required assistance for States to meet SARPs and other safety-related requirements. ICAO’s Universal Safety Oversight Audit Program also promotes the universal implementation of SARPs through mandatory and systematic audits of the civil aviation infrastructure in all Contracting States, with a view to identifying and correcting deficiencies and shortcomings in safety-related areas.

Aviation safety and new technology

6. Implementing the primarily satellite-based CNS/ATM systems will make it possible to increase the number of aircraft that can fly safely and efficiently in a given airspace. The objective of the world aviation community is nothing less than a system which provides aircraft operators with the freedom to choose a preferred flight plan with minimum constraints, while maintaining or increasing existing levels of safety.
7. The universal implementation of ICAO SARP and of CNS/ATM systems will require a unprecedented level of co-operation among countries and a corresponding level of global co-ordination in all aspects of civil aviation safety. Safety is not a national issue, nor is it a regional or continental one. It is a global issue. Human beings travel all over the world across country borders. They are entitled to a uniform application of internationally recognised safety standards wherever they may go.
8. The Future-oriented Air Navigation System (FANS) is the single, most complex and far-reaching initiative ever undertaken in the history of civil aviation. The world aviation community has the moral responsibility to do all that is humanly possible to ensure the safety and efficient development of international civil aviation. Everyone must truly believe that all are fully committed to aviation safety and to a harmonised global air transport system.

Air transport market aspects and Air Traffic Management

Introduction

1. As soon as the liberalisation of air traffic started, the aviation community realised that a genuine air-transport single market required also the establishment and uniform application of common rules in the fields of aviation safety and environmental protection. The purpose was to ensure a high level of protection for the European citizen, as well as to provide a certain degree of freedom for Community air operators. This, moreover, would facilitate the smooth functioning of the internal market for related products, persons and services, the patchwork of national regulations being frequently used to deprive them of the freedom of movement enshrined in the Treaty.
2. The current Community system is based on Regulation (EEC) No 3922/91. In the implementation of this Regulation, the Commission identified several problems which still prevent the internal market from developing completely. These are fragmentation of ATC, constraints on the physical access to the market, costs of infrastructure, the absence of an external dimension to aviation regulation and the fragmentation of safety rules.
3. Discussions within the Community showed that there was a need for a strong organisation with extended powers in all fields of civil aviation safety and the potential for taking over executive tasks currently exercised at national level. The European Parliament (EP) has also called on several occasions for the establishment of a single aviation-safety regulatory authority. In other words, it was felt that a body comparable to the Federal Aviation Administration (FAA) in the United States should be created, with the prime task of ensuring a uniform high level of safety in Europe through the gradual integration of national systems. This would not only facilitate the free movement of aeronautical products, as well as persons and services, but would also make easier the discussions, with the military authorities, on airspace use. A useful option would be to enable automatic recognition, without any further requirements, of certificates and approvals issued by any duly-authorised body on the basis of common requirements.
4. The aviation industry is in low esteem with the public, but air travel is popular as never before and airports have become attractions in themselves. Only if we plan and act together, will we be able to create a lasting positive image for the public. The ongoing dialogue between airports, airlines and indeed all partners in air transport should continue and lead to jointly borne activities that will convince all stakeholders and public opinion of the necessity of an adequate aviation infrastructure. Public-relation efforts should be coordinated, or even bundled both on the level of the trade organizations, like the Association of European Airlines (AEA) and the Airports Council International (ACI), and on ECAC and EU level.

Present Air Traffic Management in Europe

5. The way ATM is implemented in Europe is the cause of considerable delays and disruption in the regular operations of airlines, thereby generating extra economic and

environmental costs. At the root of this problem is the lack of a homogeneous network, which is a heritage of the obsolete approach to air space sovereignty still alive in the new European context.

6. The AEA has long emphasized the need for a Single Authority, which would manage European airspace as a common entity. The new Eurocontrol Convention was signed a couple of years ago and is currently being ratified. This new Convention will bring about some improvements compared with the previous situation, but is still a long way from the objectives of the first Convention of 1960, which called for Eurocontrol to exercise a regulatory role. In the re-structuring process, Eurocontrol's scope of activity has been enlarged to cover airport matters in the general concept of "gate-to-gate". At the moment we do not really know how this concept will improve traffic flow from the departure "gate" to the arrival "gate". The system should demonstrate its efficiency and, insofar as the en-route segment of ATM itself is not improved, we fail to see how adding the approach segment will automatically improve the whole ATM process. ATM failure is a major obstacle to the development of a healthy, wealthy aviation, a fact which is beyond airlines' control.

Air Traffic Management and the environment

7. In addition to delays and to the extra costs generated by congestion, which have been estimated at € 2.5 billion by the INSTAR Group¹, ATM failure is also one of the major causes of air pollution. The special report on "Aviation and the Global Atmosphere" drafted by the IPCC (International Panel on Climate Change) stated that improvements in ATM could lead to a reduction of 6 to 12% in fuel burn. It goes without saying that Eurocontrol must also make a contribution to reducing gaseous emissions from commercial aviation by reshuffling its route structure and by allowing airlines to fly at their optimum.
8. There is no cause yet for despondency. The aerospace industry is quick to learn from past errors. Nobody any longer waits for a situation to become untenable, before action is undertaken: "Pro-active" is the watchword. ECAC has played a vital role in troubleshooting, in identifying potential problems and putting strategies in place to deal with them. Before looking at the airports issue in detail, let us briefly examine this approach to date.

New Eurocontrol and ATM requirements

9. In 1977, all these strands were brought together at their fifth meeting, during which they approved an institutional strategy. This strategy was, in effect, a blueprint for a new Eurocontrol: it laid the foundations of the revised Convention, which gives more independence to the Organisation with concomitant responsibility for a much wider spectrum of tasks. It was at this meeting that the Organisation was made responsible for every element of a flight, from planning through to the payment of route charges, the range of activities that is known as "gate-to-gate" (GTG).
10. The revised Convention reflects the wishes of the ECAC Ministers of Transport that Eurocontrol should establish and subsequently manage a uniform European ATM system - a system that includes airports. This point is stressed in the preamble to the revised Convention and is repeated later, requiring Eurocontrol to "develop and endorse coordinated or common policies to improve ATM at and around airports".

¹ INSTAR stands for the Institutional Arrangement study, conducted by ECAC with the support of the European Commission.

11. European ATM capacity shortage problems can only be resolved in the long term by applying “lessons from the deregulation of other industries such as telecommunications and airlines”. Several courses of action may contribute to resolving all the problems that have appeared during the last fifteen years:
 - Considering deregulation from a political perspective
 - Restructuring monopolies
 - Setting up a central European Regulator
 - Opening of the market for ATM, including future aspects
 - Regulating competition within the aviation community.
12. It is very clear that the provision of Air Traffic Services in Europe is in great difficulty at present. All stakeholders involved in ATM Provision are ready to seek improvements. Also the corporate providers of ATM services are particularly motivated to play their part in reducing the delays seen by their end-customers, principally the airlines, as well as by the passengers, as the end-customers of these airlines. The reason is simple: once organisations are set upon fulfilling their responsibility of providing ATM services as a service industry, the customer requirements become key and no company can afford any failure to cover its customers’ needs safely and efficiently.
13. The Civil Air Navigation Services Organisation (CANSO) is anxious to do all it can to help resolve the current crisis in ATM. The nature of the problem is well known: the increase in demand for ATM has exceeded the increases in capacity provided.

Future Air Navigation System (FANS)

14. In 1983 ICAO chartered the Special Committee on the Future-oriented Air Navigation System (FANS) to study the current air traffic infrastructure and recommend changes to support the anticipated growth in air traffic over the next 25 years. The committee’s report, published in 1988, laid the foundation for the use and management of airspace. Fundamentally, the plan advocates a change from terrestrial-based technology to space-based technology. The new technology should take advantage of digital communications for data interchange.
15. To achieve the economic benefits of a modern air-transportation system, CNS/ATM is an integration of advanced, global communication, navigation and surveillance functions with a modern, efficient air traffic management system. This requires an advanced capability on the airplane which can work in harmony with the upgraded Air Traffic Control Centres (ATCC).
16. Air transport delays in Europe are a major concern for the industry and a source of complaints from the passengers. Not only is it a painful inconvenience for all parts involved, but delays also induce large costs for the airlines, their customers and the community as a whole. Of course, not all delays are the result of ATM deficiencies. The improvement of the system would, however, reduce airlines’ costs to produce a positive impact on airline operating margins and lower costs to passengers. Improving the value of services provided is a major focus for the commercial ATM suppliers. Value is improved by productivity gains and by a better understanding of customers’ needs, which brings improved systems to reduce costs.

Air traffic delays

A short analysis of air traffic delays

1. Air transport delay reduces the value of the service provided to the passengers, but is a very complex phenomenon. Further investigations are needed for a better appraisal of the various costs involved. According to the study of delays of Eurocontrol/PRU, annual overall costs for airlines and passengers could be estimated between €6.6 and €11.5 billion for 1999 with a corresponding average unit cost per minute of delay ranging from €39.4 - €48.6 for the airlines, and €46.6 - €60 incurred by passengers, respectively. In this evaluation, the cost burden for airlines (from €3.0 to €5.1 billion) as a whole, seems to be somewhat lower than the cost burden for the passengers (from €3.6 to €6.4 billion).
2. Primary and reactionary delays do not have the same impact on costs, as illustrated in the following table.

Scheduled Flights	Distribution	Airline unit costs (Euro)	Passengers unit costs (Euro)	Total (Million Euro)
ATFM primary delays	60%	40-66	47-60	87-126
Reactionary delay	40%	28	47-60	75-88

NB. These figures correspond to the actually-observed delays encountered by airlines in the course of their operations

3. Delays have financial and economic consequences for airlines, for their clients and for the community. The airlines bear additional costs in terms of fleet, as well as flying and ground personnel, since delays prevent them from operating in optimum conditions. They must also compensate passengers for the discomfort experienced and the prejudices they are subjected to. Also, according to their type of operations, airlines might experience specific costs (i.e. those linked to hub operations). Additional long-term costs might also be observed, such as a loss of competitiveness and the consequences of a degraded social climate, which follows degraded working conditions. The delay-related costs for users are mostly airline passenger's opportunity costs, measured by their valuation of time. Costs related to other users, such as military and general aviation costs, which are very difficult to address, cannot be taken into consideration in the scope of this study. The delay-related costs for the community involve environmental costs as well as costs incurred by other actors involved in the air transport business, such as hotels, travel agents, tour-operators, airports, etc.

Delays and the Environment

4. The environment could be affected by delays in two ways: aircraft emissions and noise. Air transport burns fuel in the atmosphere, which produces emissions of pollutant substances. Through lengthening flight and taxiing times, delays have an effect on the volume of emissions into the atmosphere.
 - Results of previous studies have been considered with regard to assessment of pollution and noise costs. Some research has been conducted on individual aircraft emissions along with cost evaluation on damage caused by pollution in the

neighbourhood of airports. Those results could be used, provided that statistics on delayed traffic (aircraft and engine type, phase of flight, location of occurrence) were available. Since they are not, evaluation is impossible at this stage.

- Noise is another source of annoyance, mainly to the population living under the approach and departure paths of airports. Nevertheless, new-generation aircraft have become quieter. Improved take-off performance of today's engines means that aircraft climb much more quickly after take-off. Therefore significantly fewer people under the departure flight path are being disturbed, all other factors being equal. On approach, the disturbance created by aircraft is mainly due to airframe noise, rather than to engines.

EU decisions and regulations concerning the aviation industry

1. On 16 July 1998 the European Council adopted a decision authorising the Commission to open negotiations with the European Community's Member States, with a view to concluding an agreement establishing a European Aviation Safety Agency (EASA), which will have the legal form of an international organisation.
2. Since 1989 the European Council and the European Ministers of Transportation have decided to formalise the active involvement of all Member States within Eurocontrol, as a manifestation of their will to solve ATM problems (*Council Resolution 89/C 189/02 of 18 July 1989*).
3. A series of subsequent decisions have contributed to the improvement of Eurocontrol and its technical expertise: for example, the development of the central data base of Eurocontrol and its forecasting methods, the initiation of the Co-operation Agreement between the European Community and Eurocontrol and the promotion of the participation of the Commission in studies and research programmes (e.g. PHARE, EATCHIP, APATSI, EATMP etc.), as well as the financial support provided (*Directive 93/65/EEC of 19 July 1993*).
4. The use of the technical norms and standards of Eurocontrol for the harmonisation and unification of the European Air Traffic Control systems is also prescribed by the Commission (*Council Resolution 94/C 309/02 of 24 October 1994*).
5. Saturation of air traffic and the risk of entering in crisis situations is also formally mentioned since 1995 at the latest (*Council Resolution 95/C 317/01 of 17 November 1995*). Directive 97/15/EC of 25 March 1997 sets the obligatory elements of specific Eurocontrol norms for Air Traffic Management within the European Union.
6. The Council Resolution of 17 November 1995 notes that ATM is of vital importance for the development of European air transport. It also states that air traffic congestion imposes serious losses and inconvenience both on airlines and on passengers. In general, today's congestion creates economic obstacles for air traffic within the EU, while causing inconvenience for users. Such a phenomenon reaches seasonal peaks for particular traffic flows. Saturation of air space and reduction of available ATC capacity are two of the primary causes of this congestion. An unexpected or unplanned loss of civil ATC capacity over an extended period may lead to a crisis.

7. The Council Resolution of 19 July 1999 notes that the situation in air-traffic delays is of serious concern and that this undermines the efficiency of Community air transport, causing great inconvenience to the air travellers and possibly an additional burden on the environment. Additionally, it lays the foundations for the oncoming changes in all the fields of the aviation industry and mentions all the organisations and the future role they can play in order to improve the forward planning and the efficiency of the Air Traffic Management System (ATMS) in Europe. The Council Resolution of 19 July 1999 has a huge importance considering that total scheduled passenger traffic of the world's airlines is expected to grow at nearly 5% on an annual basis.

Civil/Military Co-operation

Introduction

1. Military airspace requirements stem from aviation, ground and sea-based activities. Military aviation, on which part of this project focuses, operates a wide range of aircraft types, from large transport aircraft, through high-level and low-level ground-attack, fighter and training aircraft, to helicopters and unmanned aerial vehicles. These aircraft are required to operate in all airspace environments and have special airspace requirements in addition to general airspace use (e.g. low-level flying, in-flight refuelling and air-to-air combat training). The operation of some military aircraft, such as transport aircraft can, in general, be considered as similar to that of a commercial airline operator. Other aircraft, particularly fighters and training aircraft, often have limited physical space available in the aircraft for equipment that would enable them to conform fully with civil airspace access requirements.

Flexible Use of Airspace

2. Effective Air Traffic Management is inconceivable without close association of civil and military components. It is time to bring together civil and military expertise at European level in co-operation with NATO. Civil and military airspace requirements over the territory of the 16 NATO nations should be fully coordinated. This includes the realisation of major air exercises, the harmonisation of air traffic control systems and procedures and the sharing of communications frequencies.
3. All users - commercial aviation, general aviation, and the military- need access to airspace; zones should only be reserved permanently to any category of users when it is absolutely necessary. Military and civil users are willing to improve arrangements for coordinating usage and establish arbitration procedures. The rules have to take into account the specificities of the military use of airspace.
4. The credibility of the reorganisation of ATM in Europe depends on the involvement of military authorities in the definition and implementation of the regulatory framework, which needs predictability, clarity, and transparency for the benefit of all users. The implementation of an integrated airspace, without consideration of national borders will offer extra capacity through "Flexible Use of Airspace" (FUA).
5. This effort would allow the implementation of a more integrated management of the airspace, without the limitations of national borders, in order to maximise capacity through initiatives such as FUA, a uniformity of airspace categories and free routing,

starting with upper airspace above a certain altitude and continuing in stages to optimise capacity.

Evolution of EASA

The creation of a powerful European Aviation Organisation

1. The Commission proposal COM(2000)144 (Brussels, 21/3/2000) for the creation of a European Aviation Safety Agency (EASA) is fundamental for the continuous growth of air transportation. According to the specialists interviewed during the realisation of this project, the need for one, powerful Organisation for air traffic regulation within the EU of present and future boundaries is unanimously acknowledged. This Organisation could be the result of the evolution of EASA from an agency to a single powerful Organisation. Such an organisation will prepare the rules and the information texts for all parts involved. The Organisation's specialists will have to keep in mind all the main parameters, as well as the psychological aspects of the passengers, the crews and the rest of aviation specialists in everyday procedures.
2. The Organisation will have to develop its know-how in all fields of aviation safety in order to assist Community legislators in the development of common rules in the field and manage itself certain executive tasks where collective action would be more effective than individual action by Member States. In this way, it will assist the Commission in the monitoring of the application for common rules, as well as in the implementation of the necessary safeguard measures. It will also provide its technical assistance in contacts and negotiations with the aeronautical authorities of third Countries and international organisations competent in this area.
3. On this basis, the Organisation must be capable of executing, in co-operation with civil aviation authorities, all the tasks related to the regulation of civil aviation safety. This Organisation must exercise the necessary powers where collective action is more efficient than that of its individual members. Its scope would initially encompass the design, production, maintenance and operation of aircraft and aeronautical products, the safety aspects of airport operations and air traffic management, as well as personnel and organisational matters. A committee of the most competent organisations like Eurocontrol, JAA and the European Commission could work on this basis already in order to prepare all the above-mentioned rules, concerning all the areas of activity, guaranteeing a high level of safety in Europe and making it possible to respond as quickly and efficiently as needed.

European Aviation Organisation objectives

4. The essential objective of the Organisation would be to achieve a high, uniform level of safety and environmental protection in the Community. Additional objectives would be:
 - the facilitation of free and fair competition in the Community;
 - more efficient certification processes;
 - the world-wide promotion of European aviation standards;
 - the improvement and restructuring of Air Traffic Management services (ATMS) in total.

5. The means to achieve such objectives are:
 - the formulation, approval and uniform application of all necessary regulations;
 - the automatic recognition, without any further requirement or verification, of approvals granted in accordance with these regulations to products, organisations and personnel involved in civil aviation;
 - the establishment of a Community Organisation able to undertake the related tasks.
6. All interested parties have always recognised that the achievement of these objectives and the implementation of related means required the creation of a specialised Organisation. An Organisation with a high level of expertise in all areas related to aviation safety, productivity of the air transport industry and environmental protection. Furthermore in order to be able to play its role effectively in protecting public interests within the European countries and promoting European views outside Europe, it would need to be vested with real powers and enjoy the necessary independence. The aeronautical community needs a strong and efficient agency able to carry out certification functions and to be a valid partner for foreign aeronautical authorities.

Aviation Regulation

Expected changes in regulation

1. The regulation establishing the proposed Organisation should state the basic principles and essential requirements. They should be in accordance with the normal legislative process, while related legislation will complement the proposed Regulation. This refers basically to the safety aspects of air operations, flight crew licensing, airport operations and air traffic management in general.
2. However, in order to benefit from the expertise existing in Member States and to maintain a closeness with stakeholders, a fair balance has to be agreed. Some functions will be centralised and others will remain within national administrations (individual certifications of planes, granting of pilot licenses etc.).
3. This new structure and sharing of rules is significantly different and more radical in comparison to what was established by Regulation (EEC) No 3922/91. It is, however, necessary to retain some of its elements to ensure the proper functioning of the internal market. This is the case with automatic recognition of approvals granted by the Member States or an Organisation, in accordance with the Regulation and the rules adopted for its application.

Requirements from the European Aviation Organisation

4. The Organisation should be established as part of the Community system. It should be entitled to build on its expertise and carry out preparatory work in all areas covered by the Regulation; it might, therefore, develop international co-operation and research activities as appropriate. In all these fields the Organisation should be entitled to formulate recommendations or opinions. More precisely:
 - It should develop essential requirements and implementing rules applicable to aeronautical products, personnel and organisations and forward them to the Commission.

- It should develop and adopt acceptable means of compliance and guidance material, including airworthiness codes, for the application of the above rules.
 - It should conduct technical investigations and issue type certificates. The Organisation can carry out these tasks itself, or allocate them to national administrations and, eventually, the air transport industry when they have shown that they possess the required capabilities.
 - It should put in place a system of surveillance, including, in particular, the continuous monitoring of the airworthiness of the products for which it has issued type certificates (it would encompass Instructions for Continued Airworthiness, Design Changes including Approved Manuals, Service Bulletins, Airworthiness Directives and Repairs).
 - It should assist the Commission in monitoring the application of the common rules at national level. It should, therefore, create teams of experts for surveying the national systems and checking their working methods.
 - In the international field, it should be able to establish appropriate relations with international organisations and third-country aeronautical authorities in order to harmonise rules and procedures in the context of working agreements concluded by the Commission with these bodies, and make the necessary recommendations to the Commission. It should also assist the Commission in the negotiation and implementation of bilateral or multilateral agreements.
 - In the field of research, the Agency should have a budget for carrying out activities related strictly to its field of expertise. It should also be able to take the appropriate initiative to co-ordinate its activities and those of the Community and of the Member States in this field.
5. Decisions on safety should be made without any political interference or national considerations. These decisions should be based on a codified process, designed to ensure appropriate transparency and the right of all affected parties to present their opinions while preserving the necessary commercial and personal secrecy.
6. As for the development of a common approach to Community rule-making and acceptable means of compliance, Member States could participate in the shaping of the rules, which are to be applied by their aeronautical authorities.
7. An Administrative Board consisting of one representative of each Member State, the Commission, the European Parliament and European organisations like Eurocontrol, and the JAA should be in charge of all administrative issues.

Certification procedures

8. For carrying out the tasks described above, the Organisation would need to have a sufficient number of high-quality personnel. The already existing European organisations/agencies with appropriate experience in the field of aviation could contribute to the certification duties of the Organisation. This may be most efficient, especially, in the beginning stage. It would also be useful to set up joint teams largely calling on experts from national administrations without having to recruit them. This personnel would be additionally required to conduct the rule-making activities and organise the certification process.
9. It is in the interest of Member States, European citizens and the industry to enjoy a high level of safety on a geographical scale which will be as wide as possible. The long-standing co-operation between European countries in this field, in particular in the JAA,

has always allowed European States that are not members of the EU to take part in the work and the decision-making process on an equal footing. It should, therefore, be the intention to give the Community Organisation a pan-European dimension and allow these countries to continue to participate as fully as possible. Such participation will create numerous co-operation possibilities between aviation industries for common use and investigation in territories where it is now impossible to do so.

10. This new Community system will not work in isolation from other pan-European organisations such as ECAC or Eurocontrol, or from other international organisations involved in the field covered by this Regulation, such as ICAO. Its work and activities will be interdependent to those carried out by such organisations and should actually combine them all. The Organisation should be entitled to undertake the necessary steps for their early and close involvement, as well as for co-operation among them.
11. The legal basis should be consistent with the objective of the proposal and all the legislation adopted so far in the field of aviation, particularly where safety and environmental protection are concerned. The chosen instrument, the Regulation, is justified because an effective Community system in this field can only be based upon a harmonised and common regulatory framework, applied and enforced in an effective and uniform manner, to ensure fair competition and maintain high safety standards. Uniformity and efficiency would not be ensured by a less constraining legislative instrument.
12. The objective of this proposal is to establish a high, uniform level of safety in the Community by means of the formulation, approval and uniform application of all necessary aviation safety regulations, and the creation of a Community Aviation Organisation.
13. The current system has been criticised for not being able to ensure aviation safety oversight efficiently and in a cost-effective, productive manner. The establishment of common rules and of an independent authority for the certification of aeronautical products would overcome such deficiencies. Indeed carrying out all executive tasks at a Community level will provide effective support for Community policies - particularly on air safety, harmonisation of conditions of competition and association with other European States. Thanks to a common system, applicants for certification of aeronautical products will have only one set of procedures to follow to get an approval, which would then be valid throughout the whole Community without restrictions or additional bureaucratic requirements. This is particularly important in view of the fact that Europe's main competitors' certification mechanisms, for instance in the USA, are provided free of charge to the aircraft manufacturing industry. Additionally it will be useful during the negotiations with the military authorities for a Single European Sky with Flexible Use of Airspace as this must be in the near future.

Single European Sky

14. The European Commissioner for Transport and Energy seems to have reacted very effectively after the appearance of the big problems (delays, etc.) in the '90s. The formation of the High-Level Group in 1999 which reported on the basic political issues and procedures needed for the ATM in a Single European Sky, ended up with a schedule of immediate actions to be undertaken.

15. The plans for a Single European Sky Committee setting the regulatory framework and for a parallel advisory group putting the expertise of its members and opinions of parties involved at the disposal of the Committee show only part of the long way to go. The use of a safeguarding clause as a “pillar” for the military authorities is also part of the solution. In this way, military air forces will be able to make special use of airspace occasionally, especially in crises which may last long or in sudden emergency situations.
16. Member States have co-operated to establish a single Air Traffic Flow Management Centre (ATFMC), as decided by ECAC in Frankfurt on 20 October 1988. It is very important to revitalise and improve the co-operation between the Community and all the aviation authorities/organisations; the Commission’s participation in studies and research programmes (e.g. PHARE, EATCHIP, APATSI, EATMP etc.) should be encouraged and possible financial contributions should also be considered.
17. A big issue for the European Commission is the project SPARTF (Service Providing And Regulation Task Force) whose main target is the separation of regulatory from service tasks in ATM. As far as licensing is concerned, the European Commission does not focus on strict and total privatisation of service provision. By analogy with other sectors (e.g. telecommunications), the EU - and in its name the European Commission - sets the political mandates. The aim is to pass them to the Eurocontrol experts for investigation and standardisation and - after a complex but fruitful transition process - to set them down to the service providers.
18. The existence of numerous projects proves the “mobility” of the sector. Through the Galileo project the European Commission expressed the need of its people (European citizens) for their own independent satellite navigation system; an approach which is going to meet first the civil transportation needs and which involves financial, human and technical resources. Several other projects also exist such as EGNOS, another key issue, a project which is older than Galileo and “went” a long way in the past expressing European needs for interoperable systems. At present the European Commission is working towards the regulation of the framework regarding:
 - Airspace
 - Conditions for service provision (economic aspects, licensing etc)
 - Equipment and systems involved.
19. The possible relocation of military bases is another key issue not only for the Commission and the military authorities, but also for all parties involved. Selection criteria, political, economic and social issues are tightly linked together. There is a huge amount of information flow and information exchange among various parties for the highest possible economies of scale to be obtained in possible relocation projects. Relative costs are quite high after all, in most of the cases remaining to be examined in the future.

Future aspects of ATM

1. Despite the need to provide a cost-effective service with adequate capacity, the fundamental purpose of ATC is to ensure the safe separation of aircraft whilst in the air or on the ground. European airspace has an excellent safety record but we must recognise that increases in traffic require that the industry improve its safety levels on a continuous basis.

2. A wide range of actions is necessary to optimise the performance of the European ATM system. The airspace design for Europe must be improved: in particular, the core areas where the traffic should be locally reorganised, including “resectorisation”.
3. Gains in airspace capacity have already been achieved through the establishment of Eurocontrol’s Central Flow Management Unit (CFMU) as the central planning service for Europe. Additional benefits will be obtained as a result of the introduction of improved slot allocation algorithms and integrating scheduling. It is important that airspace be utilised to maximum effect. The role of the CFMU is to have an operational function and it should be subject to external regulation. It is not a regulator itself. However, it may be the focus of a European system, which can consist of not more than fifteen (15) CFMUs at selected areas within Europe.
4. Following the short-term improvements, it is essential that Europe adopt a strategy for the long-term development of ATM service in Europe making proper use of the new technologies becoming available, which will lead to meeting the safety, capacity and cost objectives for the period 2000-2010 and beyond.
5. New gains in capacity and efficiency can be made through the removal of national boundaries for the purposes of ATM operations and this is recommended by the ATM 2000+ Strategy². The strongest incentives for a similar outcome in ATM are customer-driven targets based on the reduction of costs and delays and providing sufficient capacity to meet demand on an on-going basis. It therefore becomes a business need to be interoperable, to use common standards and to seek coordinated solutions to the provision of additional capacity.
6. A system which transfers risks, costs and rewards to the service provider is needed to provide the incentive to improve performance in terms of service value and safety. The most important advantage of separating the responsibility for ATM service provision from the civil aviation services of States is the opportunity it affords to separate service provision from regulation which, typically, can remain a state function.
7. The introduction of performance-incentive pricing certainly entails economic regulation, and airspace and standards regulation are also needed to ensure that a single system is developed for Europe. This points the way to a further development, which is the establishment of a single Community regulatory framework.

CFMU as a part of ATC

8. The Central Flow Management Unit also plays an important role in airport capacity. The CFMU’s main role is to protect Air Traffic Control from overload and to distribute delay throughout the system as fairly as possible. But, it is also actively engaged in protecting airports. In 1998, 21% of regulations were applied for just this reason: two new airports, Malpensa and Gardemoen needed running-in time; others were affected by strikes – not only of ATC officials but others, like baggage-handlers – and had their service provision disrupted quite considerably.

² "The ATM Strategy for the years after 2000 (2000+), was developed after close co-operation among Member States of Eurocontrol and all its stakeholders. This strategy is designed for a uniform, gate-to-gate oriented European ATM concept. It aims to bring the airside part of airports into the overall ATM system network. The Strategy contains high-level objectives for all phases of flight, including airport air traffic control for the period 2000-2015."

9. The CMFU is also attempting to rationalise competing demand between ATFM slots and airport capacity. Discussions have begun with airport slot coordinators and other interested parties in order to move closer to the goal expressed in the European Commission's White Paper of having a combined ATFM/ airport slot. Dialogue is an essential part of the CFMU service. There are not many formal agreements between airports and the Unit, but as awareness of what the CFMU can do grows, contacts proliferate. This is especially true when there are unusual situations to be dealt with: fires, bomb threats, hijacks, severe weather problems. A growing number of airports are applying to have CFMU terminals installed. Although these tactical flow management terminals were intended for control centres, aircraft operators have been using them to great benefit and airports, too, now find that they can better schedule services and personnel if they have a clear, precise idea of just how much traffic is expected and when.

CNS/ATM new concept

1. CNS/ATM as defined by ICAO is "Communications, Navigation and Surveillance systems, employing digital technologies, including satellite systems together with various levels of automation, applied in support of a seamless global ATM system". There is no unique CNS/ATM solution; there is a variety of CNS/ATM-related implementations that allow benefits and return on investment to be achieved as rapidly as possible. In the short term, this is best achieved by looking at the CNS/ATM elements using two simple constraints: What exists now and what is likely to exist over the next five years.
2. CNS/ATM describes the technical concepts as well as the implementation of the infrastructure necessary for the provision of air navigation services. This also covers future concepts such as digital Data Links for transmission of operational data, the Automatic Dependent Surveillance (ADS) concept and satellite-based navigation, the Global Navigation Satellite System (GNSS).
3. Area navigation (RNAV) capability allows Air Navigation Service Providers (ANSPs) to offer the most cost-effective solutions to airspace users. GNSS supports highly accurate RNAV everywhere, including over the oceans and in remote areas. GNSS avionics are relatively inexpensive, so all levels of users can participate in RNAV operations, thus allowing ANSPs to structure airspace for maximum capacity. GNSS also gives airspace designers a further option in developing procedures that support low minima, avoid noise sensitive areas and reduce flying time in the terminal area. Ultimately, GNSS could replace all traditional aids, although there are still technical, operational and institutional issues to be resolved before reaching this goal. Core navigation satellites, GPS and GLONASS, are already in service with many operators using GPS for en-route through non-precision approach operations.
4. The character of air navigation planning in the ICAO European region is significantly affected by three important factors: its vast geographical size, its diversity and the multiplicity of intergovernmental organisations involved in aspects of planning on a less than full regional basis.
5. An essential technical basis for future concepts in the field of surveillance is the aircraft-based ADS technology. The ADS concepts must be prepared in order to achieve the integration of ADS into currently existing and future CNS/ATM systems. This service

ranges from the review and analysis of existing structures to the definition and planning of technological, infrastructural and institutional tasks, in order to support on-site demonstrations and trial programmes. Over the next five years and longer, it is expected that both primary and secondary radar will continue to be used, supplemented by Mode S Data Link where appropriate. Remote and oceanic areas will see increased use of ADS to supplement and eventually replace today's voice-based position reporting in procedural airspace.

6. The introduction of new CNS capabilities and increasingly capable ground and airborne systems will enable the evolution of more sophisticated ATM systems which will in turn enable realisation of greater benefits from the CNS systems. A fully integrated ATM system will make increasing use of automation to reduce or eliminate a variety of constraints imposed on ATM operations by current systems. ATM encompasses all of the elements traditionally associated with Air Traffic Services (ATS) and also several additional elements of the overall air navigation infrastructure.
7. FANS, or the Future-oriented Air Navigation System, is the adoption of modern technology to :
 - enhance communication links between aircraft and air traffic controllers;
 - improve a pilot's ability to assure the safety of his aircraft;and
 - increase an air traffic controller's capability and capacity to monitor and control.
8. The average passenger might wonder why, despite all this wonderful modern technology, an increasing amount of his time is spent in the airport instead of the office or at home. The simple answer is that the evolution from the FANS concept towards the CNS/ATM systems has been mainly a paper exercise. The concept has been transferred to a scale of technical alternatives without a clear-cut indication as to whether the introduction of these new techniques will solve the air traffic capacity problems for the next two decades. The projected benefits from FANS implementation pass via the search for a solution to avoid the increasing costly air traffic delays. Therefore, it is time for aviation to refocus on the CNS/ATM concept.

Conclusion

(ATM, ATC CFMU, Gate-to-gate)

Europe needs harmonized, well-managed Air Traffic Services that operate as a single entity. A comprehensive, gate-to-gate ATM Strategy to provide a framework for future growth is called for; one to follow up on the ECAC En-Route Strategy (which led to the creation of EATCHIP), as well as the Airport Strategy³. It is being provided in the ATM Strategy for the year 2000+. The realization of the ATM 2000+ Strategy and the "Gate-to-Gate" ATM activities fall under the umbrella of the EATMP, the European Air Traffic Management Programme, the successor to EATCHIP. EATMP is very much projected-oriented and is being run in a flexible matrix-style way for rapid, tangible benefits.

³ In order to alleviate air space congestion and reduce air traffic delays, which were becoming increasingly serious, ECAC launched, in the early 80's, the En-Route and Airport Strategies. These strategies were managed in their technical and operational elements by Eurocontrol and have covered a time-span ending in 2000. The En-Route Strategy will be followed up by a complete gate-to-gate ATM strategy, whereas the airport strategy has covered technological development of airport surveillance and communication systems.

As customers' needs and priorities are being established, a work programme is being prepared that will reflect each or them. This programme will consist of both new and existing projects; it is anticipated that improvements will be made through:

- streamlined management of surface traffic (including the use of enhanced electronic tools and procedures),
- revised separation standards (including wake vortex),
- minimizing the effect of adverse weather on airport capacity through the exploitation of new surveillance and communication technologies,
- better information exchange enabling collaborative planning and decision-making to be undertaken by all partners.

In 1988, the first ECAC Transport Ministers' Meeting on the Air Traffic System in Europe (MATSE/1) decided to hold dedicated meetings to remedy increasing ATC delays and decided to create the CFMU. In 1990, MATSE/2 initiated the ECAC En-route Strategy for the 90's and a mandate was given to Eurocontrol. The EATCHIP Programme became the concrete international instrument for achieving increasing en-route ATC capacity. At MATSE/3, in 1992, the Ministers of Transport set up the Airport/Air Traffic System Interface programme, known as APATSI. Recognising this situation, MATSE/4 in 1994 decided to aim for effective institutional arrangements for European ATM. In 1997, MATSE/5 agreed to a new institutional strategy and gave Eurocontrol the mandate to cater for ATM developments within an enlarged scope. This scope now encompasses all ATM operations, enabling aircraft movements "from one gate to the other at the arrival airport". "Gate-to-gate" (GTG) was accepted by EU Member States exactly 2 years ago.

To explain the need for adopting a uniform gate-to-gate system approach, we must go back to the previous – and still present – European air transport framework, where different active strategies and related programmes have led to a fragmented approach in managing flights. Each flight has been considered and managed as a series of separate, disconnected phases rather than as a continuous event.

The GTG concept can be best described as a process that considers and manages a flight as a single continuous event, from planning, through execution, to the post-flight activities. Its scope extends from the first interaction of the flight with ATM (which for commercial flights may be up to 6 months ahead of the date of the flight), through the execution of the flight on its appointed day, to performance registration and the calculation of charges for the services received after it has taken place. This concept promotes concerned decision-making and more freedom of movements within the ATM system, but requires the co-ordination of ATM planning and operational processes with those of the airports and aircraft operators in order to provide a seamless and coherent management approach.

Priority ought to be given to short-term action packages that would have an immediate impact on improving punctuality. Emphasis should also be given to greater coordination between service providers. It was also noted that some means had to be found to deal with airlines that abuse the system by filing multiple flight plans. If Eurocontrol were to provide non-live software for airlines to test out alternative slots, filing of multiple flight plans would be cut dramatically.

Such a new option covers the fields of Aerodrome Operations, Air Traffic Management, Communications, Navigation and Surveillance, Meteorology, and Aeronautical Information Services. Specific attention should be given to implementation aspects and elimination of

identified shortcomings and deficiencies. Ways and means should be identified to further improve the safety, efficiency and regularity of aircraft operations.

PART B – ARGUMENTS AND EVIDENCE

Technical solutions and benefits

CNS/ATM and Air Traffic Control Services

1. To achieve the economic benefits of a modern air transportation system, CNS/ATM is an integration of advanced, global communication, navigation and surveillance functions with a modern, efficient Air Traffic Management system. This requires an advanced capability on the aeroplane, which can work in harmony with the upgraded Air Traffic Control Centres (ATCCs). When will benefits materialise? Timing is dictated by the availability of avionics, communication infrastructure and upgrades to ATCCs. Eurocontrol, ECAC and the JAA must keep working with member States to explain and refine the CNS/ATM concept, the benefits of installing new technology and the economic necessity of a modern air transportation system.
2. The Air Traffic Control (ATC) systems of today are mostly designed to perform Air Traffic Control (ATC) and other Air Traffic Services (ATS). Also, they must be designed to be modular and flexible in order to serve all sorts of operators and air traffic volumes at international and domestic airports, Area Control Centres (ACC), as well as ATS facilities. These systems may fulfil the needs for providing Air Traffic Control Services from a single control centre and up to countrywide ATC network coverage.
3. ATC systems should meet present requirements and future growth in demand for air traffic services, while increasing flight safety. The design must follow the requirements and recommendations of Civil Aviation Organisations, such as ICAO, FAA, Eurocontrol etc. A new ATC system may be integrated with modern ATC communication systems such as ASR/ARSR radar, designed for airport / area surveillance with modern features, or with any existing ATC systems.
4. The initial development of ATM systems is concentrated primarily on ATS and Air Traffic Flow Management (ATFM). Eventually the ATM-related aspects of flight operations will be fully integrated as a functional part of the ATM system. The development of the ATM-system must be evolutionary. Transition and integration are the most difficult problems facing ATM-system designers. It is simply impractical to evolve from one system to another in timeframes less than several years in duration. There is a significant number of companies or organisations that are currently marketing products or services in the CNS/ATM disciplines. The technology for CNS/ATM, and vendors of equipment and applications currently exist to meet near-term requirements.
5. Most ATM sub-systems are presently focused on providing a more efficient flow of traffic while maintaining or increasing system safety. Examples of some of those ATM systems are:
 - Improved metering, sequencing and spacing of arrival traffic in terminal operations, using automated metering devices;
 - Improved decision-support tools for conflict detection and resolution and for flow management to accommodate user-preferred flight profiles and schedules in support of the concept of autonomous flight;
 - Provision of weather observations from appropriately equipped aircraft and a variety of aviation information to the cockpit, including information on weather and facilities status;

- Flexible routing and dynamic modifications to aircraft routes in oceanic areas in response to changes in weather and traffic conditions through the use of ADS, HF and satellite-based digital communications, GNSS, aviation weather system improvements and collaborative decision-making;
 - Routing, guidance, surveillance and control of aircraft and vehicles on the airport surface in order to maintain acceptable movement rates under all weather conditions, while improving the required level of safety.
6. Several benefits can be derived from the implementation of CNS/ATM elements. The benefits can be grouped into five categories: enhancement of safety, improvement of the economy of flight, reduction of delays, increase in airspace capacity, and improvement of controller productivity. CNS/ATM elements may also be used to implement a low cost infrastructure for less congested areas or to leapfrog the current ATC infrastructure for less industrialised nations.

FANS (Future-oriented Air Navigation Systems)

7. FANS-1/A is an initial implementation of CNS/ATM, which provides a subset of the ICAO-defined ADS and Controller/Pilot Data Link Communication (CPDLC) functions over the existing VHF and satellite Aircraft Communications Addressing and Reporting System (ACARS) data links. It is designed to allow airlines to achieve the benefits of the CNS/ATM environment. The Future-oriented Air Navigation System (FANS) committee's plan for Communication-Navigation-Surveillance (CNS) and Air Traffic Management (ATM) has launched the next generation of airspace management. By using advanced computing capability in the air and on the ground, new levels of efficiency, capacity and safety are possible. While the changes are revolutionary, the process of change is evolutionary.
8. Accordingly, the year 1999 was devoted to reviewing the effectiveness of these programmes and the impact they have had on the performance of the ATM System. Findings brought to light a contrasted picture in the sense that, whereas significant traffic increases had been accommodated while maintaining high safety levels and avoiding escalation in user charges, punctuality deteriorated, triggering acute disappointment from airspace users.
9. In addition to savings from reduced ground-based navigation aids, States implementing FANS CNS/ATM will allow their national airlines to be more competitive in today's rapidly changing environment. CNS/ATM holds the key to resolving airspace constraints and ushering in a new era of safer, more efficient flight operations. Airline customers should expect to receive significant operational benefits from their investment in CNS/ATM-related airplane systems, technology and operating procedures like GPS, FANS-1, CNS/ATM-1 and free flight.
10. It was clear to ICAO and the FANS committee that the present air navigation system could not support the predicted air traffic growth in the next two or three decades in terms of capacity, efficiency and levels of safety. The main problems they identified were:
- Limitations of line-of-sight systems in terms of propagation distance, accuracy, and reliability;
 - Difficulty of implementing and operating systems in a consistent manner around the world;

- Limitations of voice communications;
 - Lack of digital air/ground data interchange systems to support automation in the airplanes and on the ground.
11. The benefits from satellite communication and navigation and the air/ground data communications were evident. All that was needed was global implementation supported by an increasing by automated ground infrastructure and the airlines could expect a five billion dollars benefit. Meanwhile over the last twenty years, the satellite based FANS concept has evolved through the new CNS/ATM concept into the new CNS/ATM systems.
12. Until now FANS-1/A is the only system based on the original FANS concept that has been implemented. The introduction of Data Link, automatic dependent surveillance and satellite navigation capability has substantially improved the operations along existing routes and has created new routes. Trials with FANS-1/A in the Bay of Bengal and the European PETAL II continue. FANS-1/A equipped aircraft will further benefit when the number of Air Traffic Service centres with FANS-1/A capability increase. FANS-1/A is most effective in a long continuous airspace with limited existing ground infrastructure due to geographic or economic constraints. For areas of high-density traffic supported by an extensive ground infrastructure, FANS-1/A can only provide marginal benefit. In these areas CNS system improvements are also foreseen, however, the question is; how can we transfer these benefits to increase capacity?

Navigation improvements

1. Airspace capacity can be increased basically in two ways; increase the usable airspace and reduce the separation between aircraft. Conventional ground-based navigation infrastructure is built around the major routes, limiting the use of area navigation and available airspace. Introducing satellite navigation completely eliminates this constraint. Except for airspace set aside for military or political reasons, the users could fly any route they want. The major challenge with this scenario is to solve the controller dilemma: (a) increase the number of aircraft per control sector, or (b) increase the number of control sectors. Scenario (a) is difficult to achieve as the controller will be faced with more complex route patterns and (b) will become a communication nightmare due to the numerous hand-overs of aircraft between sectors.
2. To achieve the full benefit of FANS, air traffic control procedures will need to change and the separation distances between aircraft will need to be reduced. Ultimately, airlines hope to gain total freedom for pilots to select their routes and to change these routes in flight, safely and efficiently. This goal, known as “Free Flight” will ensure that the most economic, the fastest or most direct route will be flown according to the requirements of each individual flight.
 - Airlines and Air Traffic Management agencies will both be hesitant to invest in the necessary equipment until they are convinced that their costs can be recovered within a year or two. Who will have the vision to make the first move?
 - To achieve the full economic benefits of FANS, unprecedented levels of international co-operation between governments, airlines, suppliers and ATC agencies will be needed to ensure that the transition to FANS is both global and rapid, smooth and well-coordinated.

- Both thinking and determination are needed to overcome concerns about national control over airspace. Creative new approaches to the regional management of air traffic will maximise the benefits of FANS.
3. New CNS equipment, which uses space-based navigation (GNSS) and space-based communication (SATCOM), enables the consistent and potentially seamless operation of aircraft throughout the world. In conjunction with a global communication network, the system can provide capability for the Air Traffic Control, airline operations and passenger services.

The Cost-Benefit aspect

4. Air Traffic Management goals:
- Improve handling and transfer of information;
 - Extend surveillance using information derived from airborne systems;
 - Utilise advanced ground-based processing systems to improve navigation accuracy in four dimensions, accommodate a flight's preferred profile and provide enhanced conflict detection and resolution during changing traffic conditions;
 - Improve planning to facilitate more dynamic airspace, particularly in high-density areas.
5. As airlines obtain substantial savings in both fuel and time, the vision of the FANS committee will spread quickly. The result: greater levels of safety, capacity and efficiency to support the anticipated growth of the air transportation system for many years. This global effort should pay great dividends to all concerned - airline operators, ATCCs, and the travelling public.
6. Passengers can expect shorter flight times and passenger in-flight services will be vastly improved. Airlines will be able to fly more efficient routes, thus reducing their fuel and other operating costs. States and air navigation service providers will be able to reduce the number of expensive ground-based navigation aids, realising savings. Improved air transport efficiencies will make a positive contribution to States' economies; opportunities for travel, tourism and cargo shipment will increase, even as airlines reduce the environmental impact of each flight.

What does this mean in cash terms to airlines?

Benefits: US \$5 Billion airline efficiency benefits per year

Costs: US \$2.6 Billion one-off capital cost to airlines for avionics systems

(Source: Eurocontrol, Performance Review Report of year 2000).

Aspects for Consideration

7. Considerable attention to the airborne equipment, which must be prepared, is also necessary. The "heart" of CNS/ATM, the Flight Management System (FMS) provides the basic integration of navigation, communication and surveillance functions, as well as the primary pilot interface. Other key elements include Satellite Communication (SATCOM), the Global Navigation Satellite System (GNSS), display systems and Communication Management Units (CMUs). In the overall system design, human factors play a key role in certification and growth potential as the interface between ground ATCCs and the aeroplane becomes more complex.

8. The concept of the separation of service provision and regulation in ATM must be examined by every State separately. However, the applicability of the concept cannot be confined solely to the national level. Therefore at this point there is a very wide area for development under the contribution of international organisations such as Eurocontrol, the JAA, EASA and any new Organization to be established. It is generally agreed that the regulatory and the service-provider functions in Europe should be separated and that a strong European regulatory system (function) should be established taking into account the sovereignty of States and their responsibility for ATM. If the civil aviation authorities of all European States unconditionally believe in co-operation with Eurocontrol and the JAA, they will favour the creation of a proper regulatory regime for Europe.
9. The most developed European civil aviation authorities, together with their governments, are beginning to follow policies of separating the regulation of ATS from their provision. Some are also moving towards liberalisation of service provision in keeping with other service industries. According to the civil aviation authorities of several European States this trend will continue.

CAAs' proposals on new regulations

Air Navigation Services and Safety

1. The Civil Aviation Authorities (CAAs) provide Air Navigation Services (ANS) in all the States of the EU. The CAAs provide their operational services by themselves or via their wholly owned subsidiary ATM Provider (ATMP). The provision of the ANS via ATMP should be the subject of an agreement between ATMPs and the States, which enables the joint and integrated provision of the CAA ANS and the Ministry of Defence (MoD) ANS. The access to airspace should be provided on an equitable basis without discriminating against any particular class of users. Airspace users, whether military, commercial or individual leisure flyers, will want this to remain the case.
2. That element of both the CAA and the MoD ANS, which concerns Airspace Policy, can be undertaken through a Directorate of Airspace Policy. The Airspace Policy and Planning is a regulatory activity, with both safety and economic implications, which should remain in the public sector - not least because it is the mechanism which ensures that access to airspace is provided on a non-discriminatory basis.
3. A Safety Regulation Group (SRG) whose role is to ensure that high safety standards must be set up for European civil aviation. SRG has to be satisfied that aircraft are properly designed, manufactured, operated and maintained; that airlines are competent; that flight crews, air traffic controllers and aircraft maintenance engineers are fit and competent; that licensed aerodromes are safe to use, and that air traffic services and general aviation activities meet required safety standards.
4. The CAAs believe that all possible regulatory models should be assessed. To be acceptable, any system would need to satisfy at least the following six criteria:
 - Safety must not be weakened
 - The system must be as open and transparent as possible, with no opportunity for confusion or buck-passing between different regulatory bodies
 - The regulatory body or bodies must champion the interests of the flying public
 - It must offer a stable regulatory environment and not be subject to repeated change

- The costs of regulation should not be increased, unless there is a gain to the public from doing so
 - Any model must be consistent with developments in international regulation.
5. The benefits of having an integrated specialist aviation regulator: The CAA, as an integrated specialist aviation regulator, satisfies the six key regulatory principles. The following clear benefits can be identified:
- It would provide a stable regulatory framework within which to carry out the ATS private investments
 - It would be in line with international practice
 - It would provide clarity for the aviation industry and for air traffic users - avoidance of confusion over regulatory responsibility
 - It is the best solution for Airspace Policy because it preserves a successful civil/military partnership for resolving airspace-policy issues
 - Keeping the regulatory functions together would lessen the legislative load required to establish ATS as a private investment area
 - There would be no significant cost implications for regulated organisations.

Proposals for improving the performance of the CAAs

6. For CAAs the opportunity should be taken to streamline and modernize the corporate governance of the CAAs. For example, it would be possible to:
- cut the size of the CAAs Board
 - formalise representation of the consumer interest on the Board
 - include the CAA in a Council of Transport Safety Regulators, so that good practice could be shared and lessons learned from the experience of others.
7. If one considers a breaking-up of the CAAs as a theoretical possibility, the following drawbacks/negative consequences can be identified:
- Changing the regulatory framework would raise public concern about safety at the time of the private investments
 - With a European transport safety body, the necessary separation of regulation and accident investigation would be compromised
 - There would be a loss of clarity and efficiency in having three - or more - separate bodies, dealing with different aspects of aviation regulation - opportunities for confusion and buck-passing would increase
 - The break-up options would generally move regulatory functions closer to the European Community, thereby reducing the regulator's perceived independence from day-to-day political pressures
 - No major developed country has broken its aviation regulation activities into several bodies
 - European developments are likely to require major changes in regulatory roles within the next five years - it does not make sense to change the whole regulatory framework more frequently than absolutely necessary
 - There would be extra administrative and organizational costs, with some costs having to be transferred to the taxpayer.

Air Traffic Regulation

8. To ensure a safe, efficient and cost-effective Air Traffic Management system, effective regulation is required. The regulatory framework has to cover the domains of safety, overall system performance and required levels of service, airspace design, system design and economic aspects. The safety remains by default paramount in all decisions. The aim is to organise a full-fledged regulator, who is going to put into practice an expanded and stronger European regulation in the areas of safety, performance, system and airspace design, as well as economics.
9. The regulation will be dependent upon an effective regulator, who will be responsible for the definition of the rules, with which the service providers, airspace users and supply industries will have to comply, and who will also be responsible for ensuring compliance and must be able to balance the conflicting demands of the various interest groups.
10. The CAAs believe that retaining an integrated specialist aviation regulator would be the best way of maintaining accountability and responsibility; it would be more cost-effective and less risky than any of the various break-up options; it would be in line with international practice; and, given the likely changes to be introduced by the proposed European Aviation Safety Authority (EASA) to national aviation regulation as soon as possible, it would minimise regulatory upheaval at a time of change in the provision of air traffic services.
11. The current institutional arrangements in Eurocontrol are structured on its inter-governmental role and are increasingly based on the assumption that ATM is a politically controlled function. The time has come to begin the expansion of Eurocontrol from an inter-governmental body, which has the responsibility of Central Air Flow Management Service (CAFMS), to a centre for ATM training and ATC research, with a view to create four or five more centres for air flow management in Europe. The existing regulatory bodies of the Performance Review Commission (PRC) and the Safety Regulation Commission (SRC), together with the JAA, could join forces and work under the umbrella of a new European Aviation Organisation with a regulatory function, but having also research activities.
12. It is essential to recognise that European States show different rates of progress in the movement towards a more market-orientated ATM system. Significant change to Eurocontrol can only be achieved using a stepped, evolutionary approach. It is vital for the EC citizens and the reliability of the European authorities that this change should begin now and no more time should be lost. The solution to several problems lies by and large in a successful planning of a progressive application of Communication-Navigation-Surveillance/Air Traffic Management (CNS/ATM) systems and of course in an adequate response to the need for a financial, legal and institutional framework to facilitate its realisation.
13. Eurocontrol member States wish to play their full part in the task of improving and maintaining the ATM system at the level aviation safety and other factors need. This will require changes in the way that the civil aviation authorities operate, such as:
 - The adoption of the ATM 2000+ Strategy in full
 - The separation of service provision from political control

- Making service providers accountable for the safety and performance of the ATM system
 - Introducing appropriate performance incentives
 - Establishing separate regulatory authorities to protect consumers' interests.
14. This contribution involves the development of augmentation systems to the current satellite-based radio-navigation and positioning systems in order to meet civil user requirements (land, sea, air, and other non-transport user requirements) over Europe and over the whole geostationary broadcast areas:
- Identification of user requirements
 - Development, testing, technical and operational validation of the European Geostationary Navigation Overlay Service (EGNOS), which is a wide-area augmentation of existing satellite-ranging capability, integrity and wide-area differential information to users.

Eurocontrol and its role

Introduction

1. Belgium, France, Germany, Luxembourg, Netherlands and the UK created Eurocontrol in 1960; the rationale was that a collective ATC would be more efficient than individual national ones. Accordingly, once the Eurocontrol Convention was signed in 1963, the states were able to order Eurocontrol to build centres at Maastricht, Karlsruhe and Shannon.
2. A plan to build Eurocontrol ATC centres in France and the UK was abandoned. Also, Karlsruhe and Shannon, which had become re-nationalized in the mid-70s, were taken over by Germany and Ireland respectively.
3. The airline community, through its user organisations, started to press for a 'single European sky' at least ten years ago. Today there are still 65 ATC centres, with 31 different systems, 22 different computer operating systems, 33 different computer languages by 18 different manufacturers. Europe only now is near having an integrated system, despite the many initiatives that have been undertaken over the years.
4. The Aviation Community and the Trade Union Eurocontrol Maastricht maintain that there should be:
 - no more boundaries in pan-European airspace, but still taking account of national necessities
 - a substantial reduction in the number of civil and military ATC centres
 - more flexible use of airspace, normally with preference given to civil operations in peacetime
 - a fast, integrated approach to technical innovation, optimisation, recruitment, training and licensing of ATC Operators (ATCOs)
 - compatible ATC systems, languages and technical facilities
 - RVSM without any derogation
 - RNAV in common use
 - a mandatory satellite system
 - a European Enhancement Plan involving all stakeholders which responds to the needs

- of users
 - a strong, no-blame safety culture.
5. The application of system engineering principles to manage ATM information system-wide is a key tool to link ATM airport airside operations in a gate-to-gate system. ATM airport and airline information today is not extensively shared because existing systems have been developed independently. In many instances, the same information is created several times in several places by different systems. The application of system engineering principles can provide the framework for realising the sharing of flight information, critical in terms of safety and time, among all system partners of the complex ATM environment.
 6. Eurocontrol has developed a model to simulate the future behaviour of European ATM, taking account of all influences by the different system partners. This model considers airports as being a part of the global gate-to-gate system. This simulation tool is called “the Future ATM profile”. It is used for pro-active capacity management.

Eurocontrol main activities and benefits

7. In the case of Eurocontrol, we have not only common concepts and strategies, but also concrete work. Some key current CNS/ATM developments of Eurocontrol aim at optimising existing airport airside capacity. In 1998, 21% of the regulations imposed by the CFMU were concerned with airport-related problems. The usual causes of airport-related delays were weather, ground operations (airport congestion), technical failures and industrial action. Several ATFM actions address airport issues:
 - First of all, the enhancement of the tactical element of ATFM to maximise the use of ATC capacity.
 - The involvement of the Airport Scheduling Coordinators in the slot allocation.
 - The achievement of coherence between ATFM measures and airport runway slots.
 - The development of more effective ATFM management actions for unusual situations (most airport situations we handle are “unusual”, RVR, de-icing, RWY closure, etc.)
8. The main airline associations in Europe have long maintained that a worldwide activity needs global solutions. The only moves in the right direction have been the revised Eurocontrol Convention, the CEATS project by seven central European states⁴ to establish joint air traffic services, the intention of four Nordic states to do likewise and the ‘Single European Sky’ initiative of Commissioner de Palacio.
9. It emerged that new pan-European initiatives were called for to tackle urgently the short-term and to guide medium - and long - term developments:
 - The request for improvements to the Air Traffic Flow Management process in order to optimise the use of existing capacity with respect to appropriately adjusted demand, and for the national stakeholders to adhere closely to agreed targets and plans and to pave the way for a seamless European ATM system.
 - The request to Eurocontrol, in co-operation with the European Community, to establish a proper mechanism to reinforce the implementation by all the parties involved of the collective decisions taken through it (Eurocontrol).

⁴ Austria, Bosnia-Herzegovina, Croatia, Check Republic, Hungary, Italy, Slovak Republic and Slovenia.
PE 297.568/Fin.St.

- The thorough discussion of the challenges posed by the ever-increasing air traffic demand and the political consequences of attempting to eliminate completely the present imbalance between capacity and demand.
 - The continuous trend to increase capacity in line with air traffic demand, with particular regard to safety, which remains the first and foremost priority, cost, financing and practical matters.
10. Changes are foreseen in the European institutional set-up under which Eurocontrol would be called upon to take on progressively the policy role that ECAC has performed until now. In order to increase the welfare of European citizens, the Community must alleviate airspace congestion and reduce air traffic delays that are becoming increasingly serious.
11. It is clear to all organisations involved and especially to Eurocontrol that the present ANS could not support the predicted air traffic growth in the next two or three decades in terms of capacity, efficiency and levels of safety. This will happen due to:
- Limitations of line-of-sight systems in terms of propagation distance, accuracy, and reliability
 - Difficulty of implementing and operating systems in a consistent manner around the world
 - Limitations of voice communications, and
 - Lack of digital air/ground data interchange systems to support automation in the aeroplanes and on the ground.
12. New CNS equipment that uses space-based navigation (GNSS) and space-based communication (SATCOM) enables the consistent and potentially seamless operation of aircraft throughout the world. In conjunction with a global communication network, the system can provide capability for the Air Traffic Control, airline operations and passenger services, in order to meet the ATM goals, which mainly are:
- To improve handling and transfer of information
 - To extend surveillance using information derived from airborne systems
 - To utilise advanced ground-based processing systems to improve navigation accuracy in four dimensions, accommodate a flight's preferred profile and provide enhanced conflict detection and resolution during changing traffic conditions
 - To improve planning to facilitate more dynamic airspace, particularly in high-density areas.
13. The Community, ESA and Eurocontrol, in order to prove that the new concept is applicable, have to undertake the following activities/tasks:
- Establishment of a very close link between the ICAO implementation mechanism, which represents States, and other partners, so that a firm framework for consolidations and coordination can be established to facilitate a rational approach to global implementation of the new technologies.
 - Making recommendations on major issues such as financing, technical co-operation, training, sovereignty, inter-regional coordination and the role of each partner.
 - Updating the plans of the aeronautical fixed and mobile services, taking due account of the new requirements for CNS/ATM systems.
 - Reaffirmation of the general strategy of transition from conventional ground-based navigation systems to GNSS in an incremental and evolutionary manner.

- Requirements for radar service and ADS are reflected in the need to maintain the existing facilities and services in full compliance with the established ICAO Standards and Recommended Practices and to keep the radio frequency bands allocated to aeronautical services intact and free from harmful interference.
- Improvement of the existing air-navigation infrastructure through a new action plan, which will include new CNS/ATM systems based on GNSS and involve all Member States of the EU, ESA and Eurocontrol.
14. As mentioned earlier, the European Commission has established a High Level Group to assist it in developing an action plan for the creation of a single European sky. Industry members were invited to a "shadow" group by the Commission to represent the industry's interests and stimulate the debate in parallel with the activities of the High Level Group. The Commission hopes to engender synergy between the groups so as to ensure a common approach.
15. The whole effort focused its attention on 5 main goals:
- air space management
 - structures for service provision
 - regulatory frameworks
 - implementation measures and incentives
 - human factors.
16. The European Commission recently called a meeting to bring stakeholders up to date on developments towards the establishment of a harmonised system of Air Traffic Control for Europe. The Commission representative agreed to address two important, but omitted, issues of concern to ATC unions:
- how to resolve the problem of controller shortages and training
 - non-punitive reporting.
17. In the meeting of ATS stakeholders commissioner Palacio explained the high priority now given within the Commission to the need to reform Air Traffic Services. She stressed that no one group was to blame for the congestion and the dreadful delay situation encountered particularly during the summer of 1999. The Commission's Communication Paper on a Single European Sky had determined the necessity for the formation of a High Level Group complemented by an industry group to run alongside. The plan had been presented to MATSE (Ministers on the Air Traffic System in Europe) and the ministers had reacted favourably to the proposals. The Commissioner had chaired the first High-Level Group meeting at which the above five key issues had been agreed. Sub-groups would work on each so as to be in a position to meet the June 2001 deadline.
18. The intention is to achieve safe and efficient travel as a service to Europe's citizens whether travelling on business or pleasure. The Commissioner stressed that safety and efficiency were the only criteria and there was no suggestion of privatisation being considered in this case. She stressed that there was certainly room for improvement when the operation of US Air Traffic Services is taking place with twice as much activity as there is in Europe. Some of the reactions from the user organisations included:
- The system is fragmented and needs to be looked at as a whole
 - ATC works as a continuum in wartime; why not in peacetime?
 - Political will must be there in order to succeed and there is no indication of that yet

- Capacity gains can be made easily; the European Commission needs to find political levers to allow practical achievements to be implemented
 - Separation of regulation and provision would add to safety
 - Straightforward practical measures need to be put in place quickly to remove the existing "bottlenecks" (places in the air space where traffic is slowed down or held up)
 - Getting rid of bottlenecks is not possible, unless the military side is persuaded to cooperate
 - Short term measures could get started now with no change to the Eurocontrol Convention
 - Essential requirements need to be set at the right level by a neutral body.
19. It must not be forgotten that 2000's delays were still significantly worse than those of 1997, the last year of acceptable delay performance. It was reported at the meeting that the EC has appointed three consultancies to deal with the major areas of:
- regulation of airspace management and design
 - market organisation
 - economic regulation.
20. The quality of the Air Traffic Services provided should improve as States implement an agreed quality-assurance programme to be outlined at seminars and associated workshops. Several air-traffic management enhancements, which will enable more efficient use of airspace through a streamlined air route structure, including area navigation routes, will result in more efficient and economic air services. Moreover, airspace capacity will increase by using current technology to reduce separation between aircraft, without compromising safety.

Air Traffic Control Systems at Airports

Introduction

1. In the framework of improvements of the Air Traffic Control systems at airports, Eurocontrol is preparing an initiative (ASMGCS Ground Control Assistance Tools in Europe, AGATE), which aims at the development of Ground Control Assistance tools for Advanced-Surface Movement Guidance and Control Systems. This initiative will support the EUROPEAN MANUAL of Advanced Surface Movement Guidance and Control Systems for ICAO EUR. These tools are expected to improve safety and efficiency in surface-movements operations, as well as participating in the maximum use of existing capacity, especially in bad weather conditions.
2. Controllers, pilots and vehicle drivers will be assisted by different decision-support tools, which will provide:
 - an improved traffic situation awareness;
 - automatic detection of runway incursions and conflicts in between taxiing aircraft;
 - an improved aircraft guidance on the movement area;
 - an improved planning of aircraft ground movements to allow for the most efficient use of runway(s) capacity.
3. Eurocontrol is taking important steps to ensure that future European ATM developments happen within a gate-to-gate (GTG) system approach. The foundations have been

prepared with the adoption of a revised Convention. An ATM Strategy for the years 2000+ is being developed to improve overall air navigation capacity from a GTG system perspective, placing en-route, terminal and airports ATM components into a global ATM network. The EATCHIP programme, after the incorporation of APATSI activities, has undergone substantial reorganization to become the European Air Traffic Management Programme (EATMP). EATMP is adapting its working processes to involve all stakeholders more effectively into the development and the implementation of new tasks in a GTG mindset.

4. It is often said that there is a lack of airspace and airports, or perhaps, is it more a perception of a crowded sky and crowded airports? The present productivity losses and inefficiencies are mainly the results of an “open loop” air transportation system, which is driven primarily by delay and high penalty cost. The GTG concept is taking a holistic view by creating a “closed loop” air transportation system. This will enable the sharing of information between all partners involved in the management of a flight from a GTG perspective and the learning on how to plan, build, and use most effectively the capacity available.

Gate-to-Gate concept/objective

5. The air transport industry must work to find original and inventive ways of overcoming capacity and environmental constraints; it must do its utmost to improve its collective performance and expand capacity in the air and on the ground so as to offer the seamless service an ever-growing customer base expects. The GTG concept is an effective way to approach current ATM.
6. Operationally, the objective of the GTG process is to define, develop and implement a closed-loop system approach to flights based on uniform principles. This will require a well-coordinated set of actions by all system partners. It will facilitate the timely sharing of validated and up-to-date information about flights between all involved in their planning and execution, namely aircraft operators, en-route ATC, ATFM, ATC at the airport, airport operators and, not least, the airport scheduling coordinators. An essential factor in realizing this objective is the interfacing of individual information systems to provide for the smooth flow of information between partners throughout the whole ATM system. This includes interfacing with the appropriate military systems to ensure that information needed on flights for defence purposes is readily available. The process requires new attitudes and a willingness to share information. The GTG concept is a key approach for optimising the use of existing airport capacity. It will ensure that developments in airport airside operations will not be unrelated to ATM development elsewhere.
7. The ATM Strategy for the years 2000+, developed in close co-operation with Member States of Eurocontrol and all its stakeholders, is designed for a uniform, GTG-oriented European ATM concept. It aims to bring the airside part of airports into the overall ATM system network. The Strategy contains high-level objectives for all phases of flight, including airport Air Traffic Control, for the period 2000-2015.
8. Improvements are to be achieved through:
 - the improved management of surface traffic
 - revised separation standards

- the improvement of information exchange enabling collaborative planning and decision-making.
9. Some suggestions on the *modus operandi* and the key tools that would make GTG developments and operations work: collaborative decision-making and the application of system engineering principles to manage ATM information system-wide. Collaborative decision-making is based on the exchange of relevant real-time information about flights between the airport scheduling coordinators, aircraft operators, air traffic flow management, airport terminal and en-route ATC. This would enable more concerted and timely decision-making about flights between relevant ATM system partners. Information – such as delays, arrival times, gate changes, etc. – can often be useful to all system partners in helping to optimise flight handling. However, this real-time information is currently not available to all interested parties.
 10. Eurocontrol endeavours to develop common solutions in order to optimise the use of existing airport capacity with a GTG system approach. The ATM 2000+ Strategy and the ATM Strategy for airport airside operations are the fundamental foundations of such development. At the origin of the Gate-to-Gate Concept, we must quote the ECAC Ministerial Meetings (MATSE) for raising the political awareness, without which en-route ATM, approach ATM and air navigation services at airports would still be dealt with in a fragmented way. Without this awareness, we would not be able to speak of GTG today. Three years ago, GTG was not politically “acceptable”!

Joint Aviation Authorities and the necessity of reform

Introduction

1. JAA (Joint Aviation Authorities) is responsible for the production and publication of Joint Aviation Requirements (JARs) and the associated guidance and administrative documents. JAA's work was started in 1970 (when it was known as the Joint Airworthiness Authorities). Originally its objectives were only to produce common certification codes for large airplanes and for engines. This was to meet the needs of European industry, particularly for products manufactured by international consortia (e.g. Airbus). Since 1987 its work has been extended to operations, maintenance, licensing and certification/design standards for all classes of aircraft. Common procedures and the approval of design, production and maintenance organisations are covered. A single Joint Certification team, working on behalf of all the JAA countries, is used for certification of new aircraft and engines. After the successful completion of the evaluations, all States issue Type Certificates simultaneously, and on a common basis.
2. JAA is an associated body of ECAC representing the civil aviation regulatory authorities of a number of European States which have agreed to co-operate in developing and implementing common safety regulatory standards and procedures. This co-operation is intended to provide high and consistent standards of safety and a "level playing-field" for competition in Europe. Much emphasis is also placed on harmonizing the JAA regulations with those of the USA. JAA originated, as the Authorities' response to the technical and economic needs of the European Aviation Industry. However, since 1 January 1992 JAA codes, as they are completed, are referenced in the European Community Regulation on Harmonized Technical Standards and become law in the EC States.

3. JAA's objectives and functions may be summarized as follows:

Objectives:

- To ensure, through co-operation on regulation, common high levels of aviation safety within the Member States.
- To achieve a cost-effective safety system so as to contribute to an efficient aviation industry.
- To contribute, through the uniform application of common standards, to fair and equal competition within the Member States.
- To promote, through international co-operation, the JAA standards and system to improve the safety of aviation worldwide.

Functions:

- To develop and adopt JARs in the fields of aircraft design and manufacture, aircraft operations and maintenance, and the licensing of aviation personnel.
- To develop administrative and technical procedures for the implementation of JARs.
- To implement JARs and the related administrative and technical procedures in a co-ordinated and uniform manner.
- To adopt measures to ensure, whenever possible, that pursuance of the JAA safety objective does not unreasonably distort competition between the aviation industries of Member States or place companies of Member States at a competitive disadvantage with companies of non-Member States.
- To provide the principal centre of professional expertise in Europe on the harmonisation of aviation safety regulation.
- To establish procedures for joint certification of products and services and, where it is considered appropriate, to perform joint certification.
- To co-operate on the harmonisation of requirements and procedures with other safety regulatory authorities, especially the Federal Aviation Administration (FAA).
- Where feasible, to co-operate with foreign safety regulatory authorities especially FAA, on the certification of products and services.

JAA and a new European Aviation Safety Authority

4. JAA, as presently constituted, carries out its tasks of approval, certification and safety monitoring using staff of the national authorities, who also retain the responsibility for the legal proceedings of granting licences and certificates, etc. The JAA Headquarters is responsible for the process of rulemaking, harmonisation and standardization, (using specialist staff from the national authorities), the decision-making system, the "infrastructure" and various related tasks.
5. There is general agreement between the JAA members that we need a more formal and legally binding status for JAA. Therefore a special working group developed a possible text for a JAA Convention that received an agreement in principle from the JAA Board in 1995 but was not further developed as some members felt that co-ordination with the European Union was necessary.
6. Since 1997 the EU is discussing a proposal from the European Commission for the establishment of a European organization responsible for civil aviation safety. In June 1998 the Council of the EU Transport Ministers accepted the general concept for a European Aviation Safety Authority (EASA), which will be responsible for rulemaking,

certification and standardization for the application of rules by the national aviation authorities.

7. The Council asked the Commission to prepare negotiations for an international convention to establish EASA together with non-EU members. In December 1999 the Council discussed the draft documents for EASA and the alternative concept for an EU Aviation Safety Agency presented by the Commission. It was decided to explore further both concepts. Meanwhile, the Commission has developed and approved a draft Regulation on the creation of a European Aviation Safety Agency. JAA is looking forward to possible decisions of Council and Parliament in 2001 and 2002.
8. In preparing itself for the development into a future European Organization, JAA developed the Agenda for Change, which is now being implemented step by step into the JAA system. Together with the Agenda for Change, the NPA for JAR 11 has been issued and the comment period ended on 31 May 2000.
9. JAA will continue its work with the aim to become the genesis of a new European Aviation Safety Authority, or a powerful organisation that will lead the aviation community to a successful course of all the areas that will be under considerable changes in the following years.

Membership of ECAC, EU, JAA, EFTA and Eurocontrol

Countries	ECAC (38)	EFTA (3)	Eurocontrol (29)	EU (15)	JAA (33)
Albania	•				
Armenia	•				
Austria	•		•	•	•
Belgium	•		•	•	•
Bulgaria	•		•		Δ
Croatia	•		•		
Cyprus	•		•		Δ
Czech Republic	•		•		Δ
Denmark	•		•	•	•
Estonia	•				Δ
Finland	•			•	•
France	•		•	•	•
Germany	•		•	•	•
Greece	•		•	•	•
Hungary	•		•		Δ
Iceland	•	•			•
Ireland	•		•	•	•
Italy	•		•	•	•
Latvia	•				Δ
Lithuania	•				
Luxembourg	•		•	•	•
Malta	•		•		•
Republic of Moldova	•		•		Δ
Monaco	•		•		•
Netherlands	•		•	•	•
Norway	•	•	•		•
Poland	•				Δ
Portugal	•		•	•	•
Romania	•		•		Δ
Slovak Republic	•		•		Δ
Slovenia	•		•		Δ
Spain	•		•	•	•
Sweden	•		•	•	•
Switzerland	•	•	•		•
The former Yugoslav Republic of Macedonia	•		•		Δ
Turkey	•		•		Δ
Ukraine	•				
United Kingdom	•		•	•	•

Δ = Candidate Members

Civil/Military aspects of co-operation

Flexible Use of Airspace

1. The concept “Flexible Use of Airspace” has been quite often used by all parties involved and by quite different specialists in the ATM issue. The term “flexible” signals the separation of civil and military air traffic management systems and controlling procedures, depending on special or ordinary circumstances.
2. On the other hand, it also signals in a way, the “flexible” use of the words “flexible ATM”, in the sense that different parties usually give a different meaning to this term. The main point behind, is the general belief, quite widespread among high-rank military authorised persons, that “some civilians actually want to negotiate on a rather unfair basis”. The argument is that within a negotiation, a debate or a kind of such procedures, the two sides are well-prepared to give in some part of their territory, of their rights from the past, of their power at the bottom line. The approach during the last decade (with main exception the High-level Group of the European Commission for the preparation of the “Single European Sky” report) looks according to the opinion of high-level military sources as follows:

The territory, procedures and elements of power are to be set under thorough discussion and negotiation. The civil side wants – generally speaking – to hold the status quo in their own favour, while they want the part of the military side to be set under this control/negotiation procedure. The target of such an approach is quite obvious. The military side will be set under continuous pressure to abandon even more of its part, its air paths, its traffic control potential.

3. Obviously there is still a long way to go in the direction of mutual understanding of all parties involved and in setting aside “narrow” interests of all possible kinds. Such a narrow-minded approach is a rather suspicious one and has possibly been a result of past practice, when few positive steps were undertaken.
4. Civil and military authorities have to and will co-operate very closely, openly and frankly with each other. Suspicion is not the rule in this case; it is however a barrier that to some extent still exists and will have to be absolutely eliminated – or in practice will have to be treated in the politically correct way of mutual understanding.
5. The military side seems to feel more comfortable with a modus operandi of territory coverage from both military and civil aircraft, in proportion to the air traffic load to be accomplished. Moreover the common use of existing information sources for ATC and navigation systems is quite advisable for economies of scale and synergy effects. The condition of the existence of certain information filters, based upon modern information technology, should be in any case fulfilled.

Technical aspects

6. Although the ATC-implemented systems of military and civil aviation are based on common network connections, the only physical connection is between NATO and Eurocontrol at Maastricht. NATO co-operates with Eurocontrol for non-classified military flights, so information on such flights from Eurocontrol can pass to other ATC systems within Europe. The only filter which exists for NATO classified information is the absence of access (connection) to all civil Air Flow Management Services (AFMSs).

In case of a closer co-operation between civil and military ATC systems, taking into account the concept of the “Flexible Use of Airspace”, it is necessary to create other kinds of filters for the transmission of classified information.

7. The military systems for ATC and ATM in general are new systems, which can be connected with any possible computerised system, according to the NATO C3 Agency organisation. If one wants to expand the ability of using airspace for civil flights whenever possible or necessary (e.g. in the summer period) and, on the other side, to reduce the civil flights in case of training, military exercises or a crisis, he has to perform the above-mentioned connection. The connection of the military with the civil ATC systems will also increase the level of aviation safety standards.
8. Eurocontrol does not obtain any information on classified flights and flight plans, because in that case classified information could be passed to not-authorized countries. NATO for its own use has created an internal network (Intranet) which is a tool of information demonstration, presenting military flights and instructions of “how to use the system”.

PART C - TECHNICAL FILE

Introduction

1. The following brief introductory work is intended to provide a simple introduction to a very complex subject, CNS/ATM. The subject is complex because it covers several disciplines including Air Traffic Management, Communications, Navigation and Surveillance. The communications industry technologies are developing and reshaping the world we live in. This has a tremendous impact on the aviation industry. GPS has revolutionised navigation by providing accurate position data globally. Increasing traffic volumes, rescheduling due to accurate weather forecasting and insufficiently precise flight planning have congested the airways. We have the problem along many routes where daily overall traffic volumes are low but peak-hour demands cause delays. CNS/ATM is urgently needed in many countries to facilitate more efficient airline operations.
2. The phrase “Communications, Navigation and Surveillance systems” implies there are three component elements to be considered. This also means that each element may be considered separately for its contribution.

Communications

Digital Data Link

3. Digital Data Link systems for commercial aviation have existed since 1978 when the Aircraft Communications, Addressing and Reporting System (ACARS) was introducing as the VHF Data Link (VDL) for Aeronautical Operational Control (AOC). In 1998 an operational HF Data Link was established by ARINC. In effect there are global Data Link communications supplied by two Data Link service providers – ARINC and SITA and there is regional Data Link service, supplementing ARINC and SITA supplied by Japan, China, Thailand and, soon to be added, Brazil. The current character-oriented protocol Data Link service is 2400 bps over VHF and 600 bps over satellite. ICAO Standards and Recommended Practices (SARPs) have been established for the next generation bit-oriented protocol Data Links called VDL Mode 1 and 2 and SARPs are expected for VDL Modes 3 and 4. While VDL Mode 2 was expected to be operational by year 2000, Mode 3 is not expected before 2008 and there is no timetable for VDL Mode 4. VDL Mode 1 is not expected to be used.
4. Terrestrial-based VDL is well suited for the en-route, terminal and airport area where line-of-sight systems can be used. VDL is used today for ATM functions such as Pre-Departure Clearance (PDC), Departure Clearance (DCL), Digital Automatic Terminal Information Service (D-ATIS), Terminal Weather Information for Pilots (TWIP) and other ATM functions.

Satellite and HF Data Link

5. Satellite and HF Data Link are more suitable for oceanic and remote areas where VHF air-to-ground Data Link is not available. Satellite and HF will continue to be provided by private service providers. VDL may be supplied by private service providers or other authorities.

6. Satellites positioned around the equator enable moving objects, such as aircraft or ships, to communicate with each other and with fixed points on land. Messages can be sent from a cockpit, or from passengers on board, using radio signals which are bounced off one of these satellites. A station on the ground receives these messages from the satellite and routes them to their final destination which could be an ATC unit, or an airline's operations centre or the passenger's home or office. Messages to the aircraft are sent in the opposite direction.
7. Satellite communication systems are especially useful over oceans and other remote areas where no alternative communication systems are in place. In more densely populated areas and at airports, ground-based communication systems can still be used. For the international telecommunications industry the key challenge is to link these alternative systems into a seamless global network, similar in concept to the Internet.

Ground/ground Communications

8. The Common ICAO Data Interchange Network (CIDIN) makes use of the X.25 packet protocol which may be performed across leased lines or packet switched networks. X.25 permanent virtual circuits as well as switched virtual circuits are supported. The X.25 communication is supplemented by two higher, proprietary protocols. The use of the CIDIN transport service is specified for the conveyance of AFTN (Aeronautical Fixed Telecommunications Network)-formatted messages, Operational Meteorological Information data (text, weather charts) and the exchange of coordination information between operators at the CIDIN centres.
9. The X.25 Network provides a unified communications infrastructure integrating legacy, current and future technologies. This environment is supported by the deployment of software-based multi-protocol access platforms. The deployment of a flexible core network hardware and technology will provide for the capacity expansion and future technology compatibility required by the ATM applications business case. Protocols supported include: HDLC, X.25, X.25.X.6 Multicast, TCP/IP, Frame Relay and Asynchronous Transfer Mode.

Aeronautical Telecommunication Network (ATN)

10. ATN is a data communications inter-network that provides a common communications service for Air Traffic Services and meets the security and safety requirements of ATC applications.
11. ATN is both a ground-based Internet providing communications services between airborne and ground users. It supports communications applications that require either ground/ground or air/ground data communications services and integrates and uses existing communications networks and infrastructure wherever possible. The ATN is based on OSI architecture and provides its users with a robust and reliable communications service together with the option of a datagram service.
12. In the world of civil aviation this global network is known as the Aeronautical Telecommunication Network or ATN and is being designed to handle data transmissions. While verbal communications between pilots and controllers will still be possible, voice communication will rarely be needed. Data communications will allow information to be

transmitted more concisely, accurately, and efficiently without the risk of misinterpretation.

Navigation

Navaid systems

13. Traditional ground-based aids (VOR, NDB, ILS, DME) have limited range and restrict aircraft flight paths along fixed routes. Ground-based approach aids must be at specific locations to provide the lowest possible minima. Ideally, nav aids should support area navigation (RNAV). RNAV capability allows Air Navigation Service providers (ANSPs) to offer the most cost-effective solutions to airspace users. While VOR and DME can support RNAV, they cannot support high levels of accuracy unless they are plentiful. Self-contained systems (INS and IRS) are used in larger aircraft support RNAV operations, but these systems are expensive and they require position updating by external systems to maintain high accuracy.

Global Navigation Satellite System (GNSS)

14. GNSS supports highly accurate RNAV everywhere, including over the oceans and in remote areas. GNSS avionics are relatively inexpensive, so all levels of users can participate in RNAV operations, thus allowing ANSPs to structure airspace for maximum capacity. GNSS also gives airspace designers a further option to develop procedures that support low minima, avoid noise-sensitive areas and reduce flying time in the terminal area.
15. Core navigation satellites, GPS for en-route through non-precision approach operations. Current approvals require operators to retain traditional avionics and ANSPs to retain ground aids. Nevertheless, operators already obtain safety and efficiency benefits from GNSS, illustrating the advantages of the incremental introduction of GNSS technology. Where there are no other aids to navigation these benefits can be considerable.
16. With FANS, aircraft navigation is becoming safer and more accurate through the use of navigation satellites orbiting the earth. The United States has offered its military Global Positioning System (GPS) to the international aviation community, and it is in use today by a growing number of airlines. The Russian Federation has a similar system, also offered for civil use, called Global Orbiting Navigation Satellite System (GLONASS) which is not yet fully operational. Eventually, both systems will probably be used by airlines.
17. GPS and GLONASS require augmentation systems to monitor signal reliability and enhance accuracy to make them suitable for civilian use. These augmentation systems are currently being developed.

Landing Systems

18. Navigation satellites are being used today to land aircraft on runways in good weather conditions, so-called non-precision approaches and landings. For landings in poor weather conditions, so-called precision approach navigation and landing, the current Instrument Landing System (ILS) or, in certain locations, the Microwave Landing System (MLS) will be in use for some time. Eventually, however, navigation satellite systems will be used even in adverse weather conditions.

Surveillance

Automatic Dependent Surveillance (ADS)

19. Under FANS, air traffic controllers will continue to use ground-based radar to monitor aircraft over densely populated areas, however, where no radar systems exist, aircraft can now relay their positions to ATC centres via communications satellites. This concept, known as ADS, ensures air traffic controllers know exactly where every aircraft is.
20. ADS is defined by ICAO as a surveillance technique in which aircraft automatically provide, via a Data Link, data derived from on-board navigation and position-fixing systems, including aircraft identification, four-dimensional position, and additional data as appropriate. It is identified as an application to be supported by the ATN, but in the timeframe of this document it is considered that a large part of the functionality can be provided through exploitation of the FANS-1/A equipage currently being installed on many aircraft.
21. Over the next 5 years and longer it is expected that both primary and secondary radar will continue to be used, supplemented by Mode S Data Link where appropriate. Remote and oceanic areas will see increased use of ADS to supplement and eventually replace today's voice-based position reporting in procedural airspace. ADS-Broadcast (ADS-B) implementation is beyond the next five years.

Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR)

22. A Primary Surveillance Radar (PSR) operates by radiating electromagnetic energy and detecting the presence and character of echoes returned from reflecting objects. It is an active device using its own controlled illumination for target detection based on reflected radar energy. It does not depend on energy radiated by the target itself or other (uncontrolled) sources. A narrow beam in the horizontal plane allows high azimuth accuracy. Analogue or digital data processing techniques are used extensively to filter out unwanted clutter, such as Moving Target Indicator or Moving Target Detector techniques. PSR is used in conjunction with SSR and their antennas are usually collocated.
23. A Secondary Surveillance Radar (SSR) transmits coded interrogations to receive coded information from all transponder-equipped aircraft, providing a two-way 'Data Link' on separate interrogation and reply frequencies. Replies contain either positive identification (1 of 4096) or aircraft pressure altitude. The co-operative concept ensures stable receive power at the ground station. On large transport aircraft, SSR Mode A+C transponders are being replaced by Mode S transponders. Both ICAO SARPs and industry standards are available.

Implementation of Mode S

24. SSR Mode S (Elementary Surveillance). Mode S transponders are being installed in most large transport aircraft as part of the required ACAS/TCAS installations (see next page). Many current Mode A+C transponder installations are, and will stay, in service on smaller aircraft. Almost all Mode S currently certified transponders are Level 2 installations that have 'short uplink and downlink' functionality without Downlink Aircraft Parameters (DAPs). They are not designed to be updated economically to Level 4 (long uplink and downlink) functionality. The first Level 3 installation was certified in

1996 and the first Level 4 installation was certified in 1998. These were certified as Level 2 installations due to lack of an approved ground interrogator. Neither has DAP functionality.

25. An SSR Mode S radar transmits coded interrogations to receive coded information from all transponder equipped aircraft providing a two-way Data Link on separate interrogation and reply frequencies. Mode A+C aircraft are controlled with Mode A+C-only interrogations, Mode S equipped aircraft are controlled using Mode S formats (ICAO SARPs and industry standards available). Mode S elementary surveillance replies include, in addition to aircraft pressure altitude or Mode A Code, the unique 24-bit identification (1 of more than 16 million) and additional information. Mode S adds to the co-operative SSR concept whereby error detection and correction is incorporated to protect data transfer.
26. DFS (Deutsche Flugsicherung GmbH) developed a concept for a radio frequency monitor, which will be put into action shortly in order to enable measurements of ground-based and airborne radio frequency congestion in critical areas. An essential technical basis for future concepts in the field of surveillance is the aircraft-based ADS technology. The DFS offers support in developing specially-tailored ADS concepts in order to prepare the integration of ADS into currently existing and future CNS/ATM systems. This service ranges from the review and analysis of existing structures, the definition and planning of technological, infrastructure and institutional tasks, to support for on-site demonstrations and trial programmes.

Airborne Collision Avoidance Systems (ACAS)

27. Airborne Collision Avoidance Systems (ACAS), also known as Traffic Collision Avoidance Systems (TCAS), is an independent airborne system providing traffic information (see and avoid) to the pilot and generating resolution advisories in case of conflict against Mode C or Mode S equipped targets. ICAO SARPs and industry standards are available. Some features of ACAS are:
 - co-operative active surveillance on Mode A/C/S aircraft;
 - passive acquisition of mode S aircraft;
 - conflict coordination air/air via Mode S cross link between ACAS II equipped targets, air/ground communication via Mode S Data Link;
 - protected volume depends on relative closing speeds;
 - detection ranges 14 to 60 NM, surveillance range 14/18 NM forward/backward beam.

Automatic Dependent Surveillance – Broadcast (ADS-B)

28. ADS-B is a surveillance application that allows the transmission of parameters, such as position and identification, via a broadcast-mode Data Link for use by any air and/or ground users requiring it. Each ADS-B capable emitter will periodically broadcast its position and other required data provided by the on-board navigation system. Any user, either airborne or ground-based, within range of this broadcast may choose to receive and process this information. The emitter originating the broadcast need have no knowledge of what system(s) is receiving its broadcast. This capability will permit enhanced airborne and ground situational awareness to provide for specific surveillance functions and co-operative controller/pilot and pilot/pilot ATM.

29. The ADS-B application is not limited to the traditional roles associated with ground-based radar systems. ADS-B will provide opportunities for new functionality both on-board the aircraft and within the ground ATC automation system. ADS-B will have many benefits in extending the range beyond that of Secondary Surveillance Radar, particularly in airport surface and low altitude airspace.

CNS/ATM

CNS/ATM concept

1. When the ICAO Future-oriented Air Navigation System (FANS) Committee addressed the technical shortcomings of the tools then currently used in the provision of Air Traffic Services, potential technical solutions were initially proposed in regard to CNS elements. However, it was apparent that it was necessary to put these tools into an operational context, and develop operational concepts for their use in the management of air traffic. The ATM element was subsequently added to the total CNS/ATM concept.
2. The introduction of new CNS capabilities and increasingly capable ground and airborne systems will enable the evolution of more sophisticated ATM systems. Air Traffic Control facilities providing Data Link-based ATM must be capable of receiving, storing, processing, displaying and disseminating specific flight information relating to flights equipped for and operating within environments where a Data Link service is provided.
3. A fully integrated ATM system will make increasing use of automation to reduce or eliminate a variety of constraints imposed on ATM operations by current systems. ATM encompasses all of the elements traditionally associated with ATS and also several additional elements of the overall air-navigation infrastructure. It can be implemented in virtually any or all phases of the operation, airport through en-route, and provide significant gate-to-gate benefits.
4. The recognition of the value of satellite communications has enabled the development of the concept of an aircraft being able to automatically report its position anywhere in the world without the constraints of line-of-sight communications.
5. The initial development of ATM systems is concentrated primarily on ATS and ATFM. Eventually, however rather than viewing ground and air as separate functions, the ATM-related aspects of flight operations will be fully integrated as a functional part of the ATM system. Ultimately, this inter-operability and functional integration into a unified system will yield a synergy of operations that does not currently exist. The functional integration will be accomplished through the use of Data Link for data interchange between the ATM system elements.
6. The expectation is that accuracy could be improved through the rapid calculations associated with automation. Conflict prediction and detection, based on advanced computational methods should allow more direct routings. These systems will be introduced in an evolutionary manner as the need arises.
7. It is reasonable that computers and the associated software will assist controllers in accomplishing their tasks. In this light, automation is seen as one of many resources available to the human operator, who retains the responsibility for management and

direction of the overall system. Effective human-machine interfaces must therefore exist on the ground and in the air to permit interaction between the pilot, controller and ground automation.

8. The ATM system must accommodate a broad community of users and various levels of avionics equipment. A major design challenge in the development of ATM procedures and techniques using new technologies is to realise system improvements centre on the roles of the human operators. Human factors are a significant consideration in determining what can be implemented and the time and process necessary to do it.
9. The development of the ATM system must be evolutionary. There is often the temptation to try to take full, immediate advantage of the capabilities which new technologies offer. The reality is that transition and integration are the most difficult problems facing ATM system designers. It is simply impractical to evolve from one system to another in timeframes less than several years in duration. At the same time the design for the future must provide a well-understood, manageable, cost-effective sequence of improvements that keeps pace with user needs and culminates in a system meeting the safety, capacity, efficiency, regularity and environmental demands.

CNS/ATM Benefits

10. Several benefits can be identified to be derived from the implementation of CNS/ATM elements. Some may already be obtainable by implementing a single element whereas others need a combination of elements. The functions and systems needed to obtain the benefits are available or already in use in different parts of the world. The benefits are primarily economical. Functions and elements enabling the benefits often also increase aviation safety. This should be seen as a further benefit even if it may not be costed, i.e. no budget figures available. The benefits can be grouped into five categories:
 - 2) enhancement of safety,
 - 3) improvement of economy of flight,
 - 4) reduction of delays,
 - 5) increase in airspace capacity, and
 - 6) improvement of controller productivity.
11. VHF Data Link for use in ACARS was introduced over 20 years ago. GNSS and FANS-1/A avionics were certified operational in 1995. ATM functions using ACARS such as Oceanic clearances and PDC were introduced in 1993 and have been steadily added to. Other products over Data Link will be offered in the next 2 to 5 years. Aviation has been slow to take full advantage of these existing CNS/ATM elements, functions and products for a variety of reasons.

Perspectives for the coming 5 Years

12. One of the main characteristics of the CNS/ATM concept is that it relies heavily on available, innovative technologies, such as Data Link and satellite applications. Many of the CNS/ATM issues foreseen for the coming 5 years pertain to GNSS. The main visible innovation, from an institutional point of view, will be that part of the navigational assistance service offered to airspace users (GPS and, to some extent, GLONASS) that will be provided by a service provider operating from outside the national boundaries of individual states.

13. Within the timeframe considered by this paper, the various elements of CNS/ATM services will, in most cases, be provided by individual national entities (with a few exceptions such as the Eurocontrol Maastricht Control Centre). GNSS signals themselves will be provided by national organizations; the perspective of a commonly controlled and operated body for this purpose remains a much longer-term and uncertain perspective. Realisation of such a perspective would bring innovation into life: the need for institutional systems is more than obvious. Such systems already exist (EGNOS, WAAS or MSAS). The search for the need and contents of international institutional arrangements should focus on the consequences of the emergence of these new actors.
14. The questions of the ownership of digital data and of correlated responsibilities/liabilities will also be of special concern for ANSPs in particular those operated along the lines of commercial businesses. As CNS/ATM becomes truly global, similar institutional concerns will arise in the field of Data Link, where data will arise in the field of Data Link, where data will gradually be produced, conveyed, provided and used by a multiplicity of stakeholders.
15. The technical level of GNSS services, especially as far as reliability is concerned, should be defined in ICAO SARPs. Compliance by providers with these commonly developed and agreed standards should satisfy non-provider States that the signals delivered meet adequate requirements, in particular from a safety point of view.

CNS/ATM Implementation Plans to the Year 2004

16. In summary, the following important implementations are foreseen for the time up to year 2004 in Europe (ECAC) :
 - 8.33 kHz VHF channel separation
 - 1999 nad 2003 (possible 2nd phase)
 - D-ATIS from 1999
 - RVSM and ARN V.4 2001
 - ACAS 2001
 - Mode S initial implementation 2002
 - CPDLC-Pilot ATN/VDL-2 implementation 2003
 - GNSS-1/EGNOS 2003
 - ETFMS (CFMU) 2005

Other tools, services and infrastructures will also continue to evolve to support the continuously growing traffic more efficiently.

Availability and Continuity

17. Different existing documents provide the basis for answers regarding the availability of and access to GNSS signals during the 5 years timeframe considered. First, a letter sent by the USA to ICAO explains the intention to maintain GPS signals for the foreseeable future. The document includes a notification deadline of several years in respect of any fundamental change to the GPS system. The Russian government made a similar commitment regarding GLONASS. The *Charter on the Rights and Obligations of States Regarding GNSS*, endorsed by the 32nd ICAO Assembly, also provides a basis for a continuous and non-discriminatory provision of GNSS services.

Liability

18. The need for an international convention on GNSS liability has repeatedly been advocated, to properly allocate liabilities along the chain of actors involved. At this point, however, it is sufficient to say that liability rules exist to cover any and all liability issues that may arise in the course of the provision of GNSS-based services. It is true that the application of these rules would be extremely difficult in practice, in the light of the numerous parallel, successive and recourse actions which may follow a GNSS-related accident.

Economic Aspects

19. The introduction of CNS/ATM applications within a State's air navigation infrastructure should be preceded by a positive cost/benefit analysis, unless the application is to introduce basic services which do not currently exist (safety considerations). The relevance of a given option will vary from one country or one region to another, and should consequently be conducted on a case-by-case basis. The financial aspects of CNS/ATM: benefits, total costs and forecast for the next 5 years has to be studied further. The creation of a Task Force or Working Group to further develop this subject within the Community has to be considered.

Overview of a GNSS Implementation Program

1. The U.S. GPS and the Russian GLONASS have been guaranteed for use by the aviation community through ICAO, free of charge, for the "foreseeable future".
2. An advantage to Air Navigation Service Providers implementing GNSS is that they do not have to concern themselves with the design and acquisition of the primary navigation satellite systems. They are therefore able to concentrate their efforts on other aspects of implementation such as developing operating procedures and ATM techniques based on customer requirements and the capabilities of GNSS, and obtaining approval for its operational use.
3. The State civil aviation authority must authorize the use of GNSS for IFR operations. Prior to approval, there are a number of operational and technical requirements that must be met. The following paragraphs outline the basic implementation steps that should be taken.

Database-Related Issues

4. GNSS navigation information can be overlaid on existing Aeronautical Information Publication (AIP) charts. Alternatively, new routes or approaches can be designed using existing design criteria. In either case the navigation database containing co-ordinates for waypoints, fixes and navigation aids for non-precision approaches must be code-able for database purposes and safe to fly using normal piloting techniques. States must publish aeronautical charts as part of their AIP and in accordance with ICAO specifications. The WGS-84 coordinate information is obtained and stored in databases maintained by database suppliers and is then made available to all GNSS receiver manufactures. Greater care than previously taken is needed to ensure that AIS data is initially accurate, and remains so through the AIP process.

Certification and Operational Approvals

5. A civil aviation authority must set requirements for GNSS aircraft equipment which are usually based on FAA or JAA standards. Supplements to aircraft manuals are part of the installation process and must be approved by the appropriate authority. GPS receivers that are not certified for IFR flight may be used as an accessory to VFR navigation but the limitation of these receivers must be recognized.
6. The civil aviation authority must issue a document approving the use of GNSS as a means of navigation for oceanic, domestic en-route, terminal and precision or RNAV, non-precision approach, which should include any limitations on proposed operations. In some States there is also a requirement of endorse a pilot's instrument rating for the types of radio navigation aids he or she is qualified to use.

Trials and Demonstrations

7. Proof-of-concept trials and demonstrations give civil aviation authorities operational experience with GNSS and an opportunity to gather data and validate the system. However, while the information and data collected during these trials and demonstrations are valuable and are needed to pursue GNSS further, it should not be a requirement to approve GNSS as a supplemental means of navigation.

Training

8. For successful implementation of GNSS, various decision-makers should understand GNSS concepts. Orientation briefings should include the basis theory of GNSS operations including both its capabilities and limitations. Comprehensive training must be provided for controllers, pilots and inspectors.
9. ICAO has published several documents and instituted programs to assist States in their own implementations. The ICAO Circular 267-AN/159 *Guidelines for the Introduction and Operational Use of the Global Navigation Satellite System (GNSS)* should be referenced for a more detailed description of basic requirements for GNSS implementation.

Planning and Organization

10. The following summary checklist is offered as a guide for implementing (to be modified as appropriate):
 - decision to implement GNSS - appropriate level of authority,
 - information dissemination,
 - initial GNSS meeting,
 - identify technical team,
 - define requirements,
 - develop plan,
 - define ATC procedures and GNSS approaches,
 - perform GNSS surveys,
 - create GNSS database,

- produce chart overlays and/or new approaches,
- define receiver approval basis,
- purchase and install test receivers,
- conduct flight and ground inspections,
- perform operational tests/demonstrations,
- train ATC personnel,
- train pilots/operators,
- obtain advice or assistance as required.

GALILEO project

11. It is clear that GPS and GLONASS cannot alone satisfy civil aviation requirements. Augmentation in Europe is required to improve the performance of GPS and GLONASS, which can be ensured by ground-based or space-based augmentation systems. EGNOS is the European GPS augmentation. The European solution for a civil next-generation GNSS called “Galileo” is in its definition phase and its planned to be fully operational from 2008 onwards.
12. The extension to and quality of civil use depend, therefore, on the military authorities which, for example, can stop or degrade the signal at any time. At present anyone can obtain a GPS receiver, at a very modest price, that will show them their position on the road, at sea or in the mountains, but with no guarantee of accuracy or continuity of service.
13. The GALILEO programme, as presented by the Commission and supported by the European Council and the European Parliament, will be operated and controlled by civilians. Development is proposed in four phases: definition in 2000, development and validation by 2005, deployment by 2007 and operation and use thereafter. **The deployment of the European Union’s own satellite constellation** is a prerequisite for the EU’s independence in the field of satellite in orbit around the Earth at an altitude of some 23,000 kilometres.
14. Mobile phones, televisions and computer networks are used by millions of citizens in Europe in the 21st century. These applications already use satellite technology. For industry, applications are on a yet bigger scale and more diverse: for example, maritime and air navigation, international financial transactions which require very precise synchronisation, oil and gas exploration, agriculture and major civil engineering projects.
15. The European Union’s GALILEO project, supported by the European Space Agency, aims to launch a series of at least 20 satellites, which will be placed in orbit at around 23,000 km and monitored by a network of ground control stations, in order to provide world cover. For the first, the European Commission has received a mandate to run and pilot a major industrial project of global dimensions.

Ground Human Machine Interface (GHMI)

The GHMI project

1. The GHMI project was aimed at developing a next generation of controller working positions to be used in future ATM concepts. It was part of the Programme for

Harmonised Air Traffic Management Research in Eurocontrol (PHARE) and was responsible for the delivering of the Human Machine Interface (HMI) specifications.

2. The use of software assistance to the controller was found to reduce the controller's workload objectively provided that the design of the "tools" was effective enough to be also usable under high traffic load conditions. Four main GHMI specifications were produced, one for each segment of flight i.e. the Departure, En-route, Approach & Arrivals and the Multi-sector controller working positions.
3. The GHMI designs used advanced features with respect to the use of colour, windowing and software tools. Initially, such applications were regarded as highly experimental but in the end they were generally well-received and accepted. The role of various training facilities has been very instrumental in achieving such positive acceptance.
4. The GHMI project recommends that advantage be taken of the PHARE technologies and simulation platforms, which provide a unique opportunity to investigate possible future configurations in terms of controller performance and safety. Exploratory studies should also be made into integration of airborne separation assurance and the PHARE ground-based separation concept based on 4D trajectories.

GHMI benefits for the air traffic controller's job and for safety

5. The air traffic controller's job consists of complex tasks demanding a high degree of skill and active application of unique cognitive abilities such as spatial perception, information processing, reasoning and decision-making. The controller must know where all of the aircraft under his/her responsibility are, and determine how and when to take action to ensure that they remain separated from each other, while also seeing to their requests and needs for descent, climb, takeoff, departure, etc.
6. Although it is accepted that the human controller in the system has performed these tasks more than adequately over the years, it is recognized that significant improvement will only be achieved through the development of powerful decision-support software tools. The development of the CNS components and ATC automation, while not altering the role of the ANSP, provides an enhanced set of such tools, which radically changes the way that the controller's role could be fulfilled. These tools are expected to assist the controller to some degree with conflict prediction, detection and resolution.
7. Current Air Traffic Control systems are based on 3 dimensional deconfliction, as there is considerable uncertainty of an aircraft's position in time. The airspace and controller procedures are put in place to separate aircraft by keeping them within 3 dimensional tubes in space, airways and other "standard" procedures. Aircraft following these procedures are therefore separated from other "tube" procedures regardless of whether there are other aircraft present in the tube. However the use of the 4th dimension (time) on trajectories means that the aircraft can be considered to be flying within an allocated "bubble" of airspace. The size of the bubble is quite small and is not linked to the separation standards but to the requirement of the Flight Management System to smoothly recover the trajectory. It can be appreciated that the 4-dimensional procedures use less airspace and have the potential to provide more "airspace capacity" and better efficiency than the current 3 dimensional procedures that constrain aircraft to generic fixed routes.

8. There are several issues that need to be carefully addressed when considering automation of this nature. The most critical is based on the fact that aircraft do not always do what they are expected to do. The human controller is very flexible and adaptive and quite capable of compensating and/or developing alternative plans. Based on this, it is reasonable that computers and the associated software will assist controllers in accomplishing, initially, a part of their cognitive tasks. It is unrealistic to determine at this early stage, that computers could effectively replace controllers in the near-term, mainly because of their uniqueness in providing the aviation system a degree of flexibility.

Data Link technology

9. What makes CNS/ATM different from the normal procurement process is the insertion of the Data Link connectivity between the two end-system users, the pilot and the controller. Proper CNS/ATM operations require a high-level Quality of Service (QoS) in the overall system connectivity. This QoS is affected by the complex technology in CNS/ATM systems. Achieving the desired QoS means considering the procurement, installation, operation, maintenance and administrative support for the delivery and exchange of data messages between a participating aircraft end-system.
10. This Data Link connectivity must also be factored into own/buy decisions to ensure adequate CNS/ATM operations. Should the ANSP buy a Data Link system and become a Data Link Service Provider (DSP) and also provide service for non-ATM data, or contract with an established DSP? Part of this decision depends on what is the cost of providing Data Link coverage over the Flight Information Region (FIR) whether buying and installing the system or buying the service from a DSP.
11. It is expected that by 2010 there will be trajectory negotiation via Data Link between aircraft and the ground and that there will be completely silent coordination and handover between controllers even between controllers on the same sector.
12. Data Link technology effects new possibilities :
 - a) increased sector capacity with a cognitive approach to automation
 - b) increased role of ground and airborne computers.
13. The expected course of events is that an aircraft flight plan would be processed using only the ground tools to provide an initial trajectory and departure and arrival times and runways. When the aircraft logged onto Data Link it would down-link its user Preferred Trajectory to the ground system. This trajectory would replace the initial trajectory and the departure planner controller would take deconfliction action if necessary. The Departure Manager and the Arrival Manager would reschedule the runway times for the aircraft. From then on, as the aircraft progressed down its trajectory, the deconfliction would always be completed by the next sector planner controller before it entered the next sector, with planning authority being passed from controller to controller ahead of the aircraft.
14. There has been much discussion on the degree of automation. The response of controllers to automation which restricts or prescribes their action has been negative. Whereas, the automation that provides assistance was readily accepted. The tools were defined in a way that automated the functions of Air Traffic Management, trajectory generation, conflict detection and resolution, sequencing and monitoring of implementation.

15. The lesson from a project like this is that there must be full agreement on, and understanding of, the concepts involved, by all parties. There should be system-wide rather than project-based configuration management, preferably through a system's engineering function which includes pilot, controller and airspace procedures as part at the ATM System.

Conclusion

Our evaluation/proposal is based upon the fact that time constraints are quite tight, due to various delays in the realisation of certain programmes in the past. The package-programme to be adopted should normally offer quite a lot of alternative solutions, not only to the technical, but also to the institutional issues - in co-operation with the military air force of course.

Most of the solutions on the technical issues are already given. However, their application is still being delayed, due to the peculiarities and seriousness of the aviation safety matter in general. Concerning the institutional issue a brand new organisation or the promotion of Eurocontrol (PRS, SRS), in co-operation with JAA, as a single regulation and coordination centre, is necessary, at least at the beginning of the coming new era in avionics.

In the future, it may be better to organise four to five centres for coordination of air flow management in the whole of Europe, with the same principles, equitable distribution of workload and specialists trained at the original CFMU.

Also, under the present circumstances, the institutional aspects of CNS/ATM can be adequately accommodated by existing arrangements, although some of them, such as ICAO SARPs still need to be expanded to cover this issue. The fact that extensive CNS/ATM applications are already in operational use throughout the world tends to support this element.

Further, moving from the present context to a long-term CNS/ATM concept will not happen overnight, but rather on an incremental basis. This paper consequently contends that changes to the current institutional framework should be brought gradually, as the context evolves, and as required by the introduction of new options.

However, as CNS/ATM reaches a global status, an increasing number of stakeholders still, in a way or another, take part in the provision or operation of services and systems. Many of them emphasize the need for clear relations to be defined among the various stakeholders, in light of both the commercial opportunities and potential liabilities which may arise from CNS/ATM. Consequently, it is recommended that the Community carefully monitors the development of the long-term CNS/ATM concept.

ANNEX I - ACRONYMS – ABBREVIATIONS

ACARS	Aircraft Communications Addressing and Reporting System
ACAS/TCAS	Airborne Collision Avoidance System
ACC	Area Control Centre
ACI	Airports Council International
ADS	Automatic Dependent Surveillance
ADS-B	Automatic Dependent Surveillance - Broadcast
AEA	Association of European Airlines
AFMS	Air Flow Management Service
AFTN	Aeronautical Fixed Telecommunication Network
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Services
ANSP	Air Navigation Service Provider
AOC	Air Operator Certification
AOC	Aeronautical Operational Control
APATSI	Airport Air Traffic System Interface
ATC	Air Traffic Control
ATCC	Air Traffic Control Centres
ATCO	Air Traffic Control Operator
ATCS	Air Traffic Control System
ATFM	Air Traffic Flow Management
ATFMC	Air Traffic Flow Management Centre
ATM	Air Traffic Management
ATMP	Air Traffic Management Provider
ATMS	Air Traffic Management System
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
bps	bytes per second
CAFMS	Central Air Flow Management Service
CANSO	Civil Air Navigation Services Organisation
CEATS	Central European Air Traffic System
CIDIN	Common ICAO Data Interchange Network
CFMU	Central Flow Management Unit
CMU	Communication Management Unit
CNS	Communication-Navigation-Surveillance
CPDLC	Controller/Pilot Data Link Communication
CTMO	Centralised Air Traffic Flow Management Organisation
DAP	Downlink Aircraft Parameters
D-ATIS	Digital-Automatic Terminal Information Service
DCL	Departure Clearance
DFS	Deutsche Flugsicherung GmbH
DME	Distance Measuring Equipment
DSP	Data Link Service Provider
EANPG	European Air Navigation Plan Group
EASA	European Aviation Safety Agency
EATCHIP	European Air Traffic Control Harmonisation and Integration Programme
EATMP	Eurocontrol Air Traffic Management Programme
EC	European Commission
ECAC	European Civil Aviation Conference
EGNOS	European Geo-stationary Navigation Overlay System

EP	European Parliament
ETFMS	Enhanced Tactical Flow Management System
EU	European Union
Eurocontrol	European Organisation for the Safety of Air Navigation
FAA	Federal Aviation Administration
FANS	Future-oriented Air Navigation System
FIR	Flight Information Region
FMS	Flight Management System
GASP	Global Aviation Safety Plan
GAT	General Air Traffic
GHMI	Ground Human Machine Interface
GLONASS	Global Orbiting Navigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HMI	Human Machine Interface
ICAO	International Civil Aviation Administration
IFR	Instrument Flight Rules
ILS	Instrument Landing System
INS	Inertial Navigation System
JAA	Joint Aviation Authorities
JAR	Joint Aviation Regulation
MATSE	Ministers on the Air Traffic System in Europe
MoD	Ministry of Defence
MLS	Microwave Landing System
NDB	Non Directional Beam finder
NPA	Notice of Proposed Amendment
OAT	Operational Air Traffic
OSI	Open Systems Interconnection
PDC	Pre-Departure Clearance
PHARE	Programme for Harmonised Air Traffic Management Research in Eurocontrol
POEMS	Pre-Operational European Mode S
PRC	Performance Review Commission
PSR	Primary Surveillance Radar
QoS	Quality of Service
RANP	Regional Air Navigation Plan
RNAV	Area Navigation
RVR	Runway Visual Range
RWY	Runway
SARPs	Standards and Recommended Practices
SATCOM	Satellite Communication
SPARTF	Service Providing And Regulation Task Force
SRC	Safety Regulation Commission
SRG	Safety Regulation Group
SSR	Secondary Surveillance Radar
TWIP	Terminal Weather Information for Pilots
VDL	VHF Data Link
VFR	Visual Flight Rules
VHF	Very High Frequency
VOR	VHF Omnidirectional Radio Range
WAAS	Wide Area Augmentation System

ANNEX II - ICAO/NATO/CAA/Airlines Questionnaire

1. Are there delays in the flights of your company due to saturation in Air Traffic Management? If “yes”, please indicate the percentage.
2. Which actions are undertaken by your company in the direction of avoidance of such delays (complaints to international organisations, participation in specific meetings) ?
3. What economic consequences exist or are visible for your company in the near future, due to delays ?
4. Do you have any kind of knowledge concerning some complete modern CNS systems (like GNSS, ...), which could contribute to the solution of such problems in the future ?
5. Do you believe that, apart from the technical changes, it is necessary to provoke changes in legislation concerning civil air transportation in Europe ?
6. Do you believe that big aeroplanes like Jumbo, A340 etc. could partially contribute to the solution of similar problems (thanks to possible lowering in the need of flights or for any other reason) ?
7. Do you believe that big airports, like Heathrow, Frankfurt etc. will partially contribute to the solution of such problems (thanks to many runways, to modern ATC systems for better ATFM) ?
8. Do you believe that collaboration among air companies will partially contribute to the solution of similar problems (thanks to better fleet management) ?
9. What is your opinion concerning the work/function/effectiveness and the services of Eurocontrol ? (Please make all possible comments) .
10. Do you believe that, the systems/equipment used by pilots on modern aircraft cover the needs of a flight by 100% ?
11. Comment on the work of Air Traffic Controllers and if the application of modern systems will help them in their work and is going to increase aviation safety.
12. Do you believe that Eurocontrol could play a more regulative role successfully?
13. Please comment on the role/relationship of Eurocontrol to the member States of the European Union (EU).
14. Please comment on the possibility of formation of a common “single civil aviation authority” for Europe.
15. Are there enough Communication, Navigation, Surveillance aids for the support of the European Air Traffic Control ?
16. How can the amelioration of air traffic become true ?
17. Comment on differences of existing Air Flow Management Systems (AFMS).
18. How does territory Air Traffic Control for civil/military air transport over Europe take place ?
19. How does territory Air Traffic Management for civil/military air transport over Europe take place for NATO flights?
20. Please comment on the role/relationship of Eurocontrol to the Member States of the European Union (EU).
21. In your opinion how difficult/easy is it to integrate CNS systems for civil and military aircraft?
22. Can a mixed commission of specialists from civil aviation and military aviation work on the enhancement of the ATC systems?
23. How difficult is it, for the military authorities, to accept an elimination/minimisation of airspace for military use during peace time?
24. Do you think it would be of any help in case military authorities of different European States used common areas of airspace for training ?
25. How do you think NATO could organise training of military and civil Air Traffic Controllers?

26. Do you think it would be of any help to establish three to five Air Flow Management Centres (AFMC) for better co-ordination of ATC ?

ANNEX III - Schedule of Interviews

- Civil Aviation Authority of Greece / realised
Mr. Papanastasiou Theodoros, Air Traffic Controller, Project Manager of radar setting in major airports of the Greek territory within the last five years.
- Hellenic Air Force (HAF) / realised
Mr. Sidiras Themis, Air Traffic Controller, HAF representative at the Athens Civilian Airport. Mr. Sidiras has worked, as NATO representative from Greece, for almost 3.5 years at the Air Traffic Operational Centre of Eurocontrol at Maastricht.
- Hellenic Air Force (HAF) / realised
Major Tsirogiannidis Dimitris, Head of the Department for Operation planning at the Tanagra airport, Pilot of Mirage F1.
- NATO C3 Agency, Command and Control Agency, The Hague / realised
Barry P. Brown, Head of Surveillance Branch,
Jean-Paul Massart, Principal Scientist, Air C² and Sensor Division
- NATO Air Traffic Management Committee (NATMC) / realised
Belgium, Brussels
- European Commission, Directorate-General VII – Transport / realised
Gerry O’Connell, Detached National Expert, Air Traffic Management Unit
Fotini Ioannidou, Principal Scientist on ATCS
- Aegean Airlines, / Athens, Greece / realised
Mr. Pehlevanoudis Zisis, Director of flight exploitation, chief pilot.
- Axon Airlines, / Athens, Greece / realised
Mr. Tzanes, Director of flight exploitation, chief pilot.
- British Airways / London, England / realised
Mr. G. Ramkin / captain
- Air France / Paris, France / realised by e-mail
Mr. A. Castaing / captain
- Lufthansa / Frankfurt, Germany / realised by e-mail
Mr. J. Juenemann / captain
- Eurocontrol / rue de la Fusée, B-1130 Brussels, Belgium / Performance Review Unit / realised
Mr. Xavier FRON
- Joint Aviation Authorities / Saturnusstraat 8-10, 2130 KA Hoofddorp, The Netherlands / realised by e-mail
Mr. A. Kalshoven, Production Co-ordinator
- ICAO / European and North Atlantic Office / procurement of bibliography

Paris, France.

- ECAC / Paris, France / realised by e-mail
- IATA Centre / 33, Route de l'Aéroport, Geneva, Switzerland / realised by e-mail
Mr Steve Zerkowitz
- IATA Greece / 8, Ioannou Metaxa Street, Athens / realised
Mrs Bousioti
- ACI / Geneva, Switzerland / realised by e-mail
Maria Hinayon, Senior Manager Statistics & Data Processing
- DFS / Karlsruhe, Germany / realised
Klauspeter Hauf
- CAA / Safety Regulation Group / Aviation House Gatwick Airport South, Gatwick,
West Sussex, England / realised
Mr. N. Asbury
- Irish Aviation Authority / Aviation House, Hawkins Street, Dublin 2 / realised by e-mail
Lilian Cassin, Corporate Communications Officer
- European Regional Airlines (ERA) / The Baker Suite, Fair Oaks Airport, Chobham,
Woking, Surrey, GU24 8HX, UK / realised
Air Safety Manager, Mr. John Barrass

ANNEX IV - Bibliography

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