

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 1: Introduction and assessment of a global air traffic management (ATM) operational concept

1.2 Enabling concepts in support of the global ATM operational concept

:

THE DESIGN OF AIRSPACE STRUCTURES

(Presented by the European Organisation for the Safety of Air Navigation – EUROCONTROL, on behalf of its Member States and those of ECAC¹)

SUMMARY

The ATM Systems in Europe have to cope with an increasing air traffic demand. To meet this constantly increasing demand, the European Civil Aviation Conference (ECAC) and EUROCONTROL States are aiming to enhance capacity and efficiency in the airspace through the application of modern airspace design principles taking advantage of state-of-the-art technological developments and new operational concepts.

EUROCONTROL is, in cooperation and coordination with high-level airspace planners from the States, both civil and military, and representatives from the users, in a constant process of improving the design and organisation of airspace structures, based upon a set of agreed design principles.

REFERENCES

1. EUROCONTROL ATM 2000+ Strategy, 2002 edition:
http://www.eurocontrol.int/eatmp/library/documents/DraftVol1_10e-clean.pdf
2. EUROCONTROL Airspace Strategy for the ECAC States
<http://www.eurocontrol.int/eatmp/library/documents/airspace.pdf>

¹ The ECAC Member States are: **Albania**, Armenia, **Austria**, Azerbaijan, **Belgium**, Bosnia and Herzegovina, **Bulgaria**, **Croatia**, **Cyprus**, **the Czech Republic**, **Denmark**, Estonia, **Finland**, **France**, **Germany**, **Greece**, **Hungary**, Iceland, **Ireland**, **Italy**, Latvia, Lithuania, **Luxembourg**, **Malta**, **Moldova**, **Monaco**, **the Netherlands**, **Norway**, Poland, **Portugal**, **Romania**, Serbia and Montenegro, **the Slovak Republic**, **Slovenia**, **Spain**, **Sweden**, **Switzerland**, **The former Yugoslav Republic of Macedonia**, **Turkey**, **Ukraine** and **the United Kingdom**).

The 31 Member States of EUROCONTROL appear in **bold**.

* French, Spanish and Russian versions provided by EUROCONTROL.

3. Airspace Management Handbook
http://www.eurocontrol.int/eatmp/fua/asm_without_annexe.pdf

1. INTRODUCTION

1.1 In the “ECAC Strategy for the 1990s” it was considered that “Efficient airspace management is fundamental to increasing the capacity of the air traffic services (ATS) system. The optimisation of the ATS route network and airspace structures is considered as a key element in obtaining the required system capacity”.

1.2 Since then, considerable effort has gone into improving airspace design. However, European airspace structures are still complex and disparate. There is a requirement for simplification and harmonisation of the organisation and the use of the airspace, enabling the European ATM system to cope with the constantly increasing demand placed upon it by the different types of airspace users active in the area.

1.3 This requirement is recognised in the EUROCONTROL Air Traffic Management Strategy for the Years 2000+ (Reference 1), and one of the main areas for change concerns the organisation and use of airspace. The first strategic principle of the Strategy states that “the airspace of the ECAC States shall, for ATM purposes, be considered a continuum and shall not be constrained by national boundaries”. The Strategy also emphasises the need for a sufficiently flexible organisation of airspace, and calls for a more responsive airspace management process.

1.4 To ensure optimum efficiency and to allow for maximum capacity, the EUROCONTROL Airspace Strategy for ECAC States builds on the EUROCONTROL ATM 2000+ Strategy and identifies a set of strategic objectives giving guidance as to the directions for change that are required.

1.5 The challenges one is faced with in creating the required capacity, calls for an innovative approach to airspace organisation and management, in particular on issues related to airspace design, such as the structure, division and categorisation of airspace, as well as the rules that apply for the use of a set portion of airspace.

1.6 This paper discusses the European approach to airspace design, concentrating on short- to medium-term developments. For the longer-term future it is envisaged that the European airspace will move towards a concept where the users are free to choose their preferred trajectories as far as possible, when safety and capacity permit it.

2. THE EUROPEAN APPROACH TO AIRSPACE DESIGN

2.1 Airspace design cannot be looked at in isolation, as each individual State is an integral element of the ATM system. Only a multi-national approach allows for a functional airspace design, which then can be based on the requirements of the natural flow of traffic. Such an approach, however, requires support facilities, and appropriate institutional arrangements, in order to be able to implement improvements in a continuous cycle, matching the annual increase in demand and gradual change of traffic flows.

2.2 In cooperation with the ICAO European and North Atlantic (EUR/NAT) Regional Office, EUROCONTROL has carried out this task by organising and co-ordinating the planning and implementation activities for improving the ATS route network in the area of ECAC Member States of the European Region. In order to define, develop, validate, implement and oversee the overall coherency and compatibility of planning, a dedicated body has been set up, consisting of high level airspace planners, including representatives from both civil and military authorities in the area of ECAC Member States, together with representatives from ICAO and airspace users.

2.3 Work is progressed through three parallel activities, focused on overlapping short- and medium-term developments. The short-term improvements is an annual activity, aimed at developing remedial proposals to alleviate airspace problems and bottlenecks that become evident during the peak summer period. The process starts during the summer with a review of the performance of the ATM system. Problem areas are highlighted and where shortcomings in the airspace structure is detected, initial proposals to improve the situation are developed.

2.4 In the medium term, new, updated versions of the Area Route Network (ARN), designed to enhance the capacity of the ATM system through airspace structure and route network improvements, are promulgated every three to five years. Each new version of the ARN makes use of available concepts and techniques. Version 3 (the different phases were implemented between 1998-2001) introduced significant improvements based on route alignments made possible through the mandatory requirement to carry basic area navigation (B-RNAV) equipment. Version 4 of the ARN (implementation started in 2001, still ongoing) was designed to ensure that the concept of reduced vertical separation minimum (RVSM) could be implemented safely and the potential capacity gains realised.

2.5 The development of a new version of the ARN is a pragmatic process, where new versions build on the previous one. In addition to this step-by-step process, there is also a requirement for a more long-term approach, with the objective of providing a “target airspace structure” towards which each successive version of the ARN can aim.

2.6 This target airspace structure is presently under development. It will employ new, advance airspace design principles, and it will require the application of an operational concept that corresponds to and supports the dynamic characteristics of airspace management that will be made available. This operational concept has to be based on a collaborative planning process, in which the real-time requirements from the various users are taken into account in order to use the airspace in the most dynamic and efficient way. Changes in the natural flow of traffic during different times of the day will be used to make decisions on how to:

- a) best use available capacity (capacity management);
- b) best accommodate the requirement for airspace reservations/restrictions of a temporary nature; and
- c) best provide operators with preferred routeings.

2.7 The overall objective of the developments described above is the enhancement of ATM capacity through the implementation of evolutionary improvements to airspace structures and the route network. In addition, these developments has the potential to meet the requirements of the European

Community's regulations for the Single European Sky on optimised route and sector design in the upper airspace, as well as being an important building block towards the concept of free routes, where users will be able to choose their preferred trajectories as far as possible, when safety and capacity permit it, without being constrained by a pre-determined route network.

2.8 The difficulties in achieving these objectives must not be underestimated. The diversity of current airspace structures among ECAC States, together with the multitude of operating techniques both of ATS providers and airspace users, will inevitably require varying degrees of difficulty to be overcome in the quest for harmonisation. This is recognised in the EUROCONTROL ATM Strategy for 2000+, where it is foreseen that one of the required new initiatives is the development of a regulatory framework to provide effective and timely common rules governing ATM service application and provision by all States.

3. AIRSPACE DESIGN METHODOLOGY

3.1 The methodology for processing work is based on cooperation and coordination between all parties concerned, and is based on a set of agreed principles and criteria. The outcome of the process provides States with an internationally agreed broad and basic concept of airspace and route structure in the area of ECAC Member States, serving as a basis for future national and regional planning.

3.2 The development of each new version of the ARN makes use of available concepts and technologies, such as the already mentioned application of BRNAV and RVSM. Another important facilitator enabling improvements to the route network, is the EUROCONTROL Flexible Use of Airspace (FUA) Concept. The basis for the FUA Concept is that airspace should no longer be designated as either military or civil airspace but should be considered as one continuum and used flexibly on a day-to-day basis. Consequently, any necessary airspace reservation/restriction should only be of a temporary nature.

3.3 Flexibility in the use of airspace is enhanced by real-time civil/military co-ordination capability. To achieve this flexibility, conditional routes (CDR) are used. CDRs are non-permanent parts of the published ATS route network, which can be planned and used only under certain specified conditions. CDRs will be established in different categories and will permit the definition of more direct and alternative routes by complementing and linking to the existing ATS route network.

3.4 The evolution of military aircraft over recent years is significant, particularly with regard to the expansion of the operating envelopes of the new generation military aircraft. As a consequence, training requirements are likely to become more varied and more complex, which will inevitably require a more flexible approach to air traffic management if the requirements of both civil and military aviation are to be adequately accommodated.

4. THE PLANNING PROCESS

4.1 The planning process starts with an in-depth analysis to identify current and foreseen problems, highlighting the weak links in the airspace structure. It progresses from broad proposals towards specific solutions, and is performed in accordance with relevant ICAO Standards and Recommended Practices (SARPs).

4.2 Improvements to the ARN are developed based on a number of agreed planning principles. These principles include that planning should take into account the needs of both civil and military airspace users, as provided for through the application of the FUA concept.

4.3 Another important planning principle is that route network planning should take place in a seamless way, disregarding flight information region (FIR) boundaries. Delegation of ATS should be utilised where necessary to enhance the capacity and efficiency of the ATM system. FIR boundaries and ATS limits of responsibility should not constrain such delegation. The following examples indicate where such ATS delegation should take place:

- a) when alignments of routes drawn independently of FIR boundaries determine the location of crossing points close to existing FIR/sector boundaries, in order to provide the controller with sufficient anticipation with respect to entering traffic;
- b) when alignments of routes affect an FIR airspace for a short distance, in order to avoid the hand-over of aircraft and additional co-ordination workload;
- c) for terminal sectors (vertical and/or geographically) in order to enable the controller to anticipate the regulation/vectoring of inbound traffic flow.

4.4 It is recognised that in order to optimise the use of airspace capacity in the area of ECAC Member States, there is a requirement for an extensive network of cross-border ATC sectors. To simplify this process and enhance transparency for the users, the ECAC States have decided to harmonise the choice of ICAO Airspace Classification, and apply ICAO Class C above FL 195, with additional restriction on VFR flights, applicable throughout the entire ECAC area. Implementation will be phased, with an initial target date of 27 November 2003. Ongoing work on the harmonisation of airspace classification applied at and below FL 195 is being coordinated by EUROCONTROL.

4.5 The planning process should normally expand from the core area to the periphery. It also recognises the need to integrate route network and supporting sectorisation at an early stage. Although the start of airspace development process is network-oriented, there is a close two-way inter-relationship between the network's structure and sectorisation definition.

4.6 The traffic in the area of ECAC Member States is predominantly short haul traffic with nearly half of the flight distance spent in climb or descent phases. Interfacing segments between the enroute and the terminal manoeuvring area (TMA) phases of flight are usually heavily loaded. From the first stage of the network planning, it is therefore necessary that planning consistently integrate transition routes (connecting the en-route phase with the TMA) into the overall route structure and to ensure TMA-Network interface compatibility.

5. CONCLUSIONS

5.1 The objective of the airspace design process is to try to accommodate the needs of all users, both military and civil, through the implementation of evolutionary improvements to airspace structures and the route network. As each individual State is an integral element of the ATM system, only a multi-national approach, to which both civil and military expertise participate, allows for a functional airspace design.

5.2 EUROCONTROL has for the last ten years, carried out the task of organising and co-ordinating this process for the States within the ECAC Area. A dedicated body, consisting of senior level airspace planners, including representatives from both civil and military parties, as well as representatives from ICAO Secretariat and airspace users, have been set up to define, develop, validate, complement and oversee the overall coherency and compatibility of route network planning.

5.3 The methodology for processing work is based on cooperation and coordination between all parties concerned, and is based on a set of agreed principles and criteria's. Work is progressed through three parallel activities, focused on overlapping short- and medium-term developments. In addition, there is a requirement for a more long-term approach, seeking to provide a "target airspace structure", towards which planning should aim.

5.4 Planning of ATS routes aims to enable a majority of flights to operate along or as near as possible to the direct route from origin to destination, and network development should therefore be processed in such a way that major traffic flows can be carried out in as straight as possible channels in so far as this does not adversely affect ATM capacity. The requirements of all users must be taken into account in this process, necessitating enhanced real-time civil/military co-ordination capability to allow for the required flexibility.

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