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EUROCONTROL

Volume 2

ECAC AIRSPACE PLANNING MANUAL

- COMMON GUIDELINES -

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Abstract

This document contains planning elements and methods of application for a common airspace design and change process in the ECAC area. This Planning Manual would then serve as a model for States to update and harmonise their own national airspace planning and allocation process with their neighbours.

The material in this document is intended to supplement the provisions specified in ICAO documents and in the Flexible Use of Airspace Reference Documents and it should therefore be used in conjunction with these documents.

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SECTION 1

INTRODUCTION

1.1 PRESENTATION OF THE MANUAL

1.1.1 About the Document

1.1.1.1 This document constitutes Volume 2 of the ECAC AIRSPACE PLANNING MANUAL which contains detailed planning elements and methods of application for a common airspace design and change process in the ECAC area.

1.1.1.2 The manual will be reviewed periodically to ensure that the planning criteria remain valid in the light of the progress made and experience gained, and to reflect the actual changes which take place in aviation.

1.1.1.3 The ECAC AIRSPACE PLANNING MANUAL is intended to serve as a model for States to update and harmonise their own national airspace planning and allocation process with their neighbours.

1.1.2 Responsible Body and Acknowledgement

1.1.2.1 This document has been developed by the EUROCONTROL Airspace and Navigation Team (ANT). It is expected that the ECAC AIRSPACE PLANNING MANUAL and its future amendments will be endorsed in accordance with the EUROCONTROL EATMP procedures.

1.1.2.2 The EUROCONTROL Agency wishes to acknowledge the valuable assistance received from Member States, the International Council of Aircraft Owner and Pilot Associations (IAOPA) and ..... in preparing this Planning Manual.

1.1.3 Structure of the Manual

1.1.3.1 The ECAC AIRSPACE PLANNING MANUAL comprises two volumes. Volume 1 describes the institutional framework and applicability of the document, whereas Volume 2 (this document) contains detailed guidelines and planning criteria.

Section 1 - **Introduction** - describes the purpose of the document, its contents, the link with other airspace-related documents and its management process

Section 2 - **Guidelines for ATS Airspace Classification** - provides guidance for the harmonisation and simplification of ECAC Airspace Classification.

Section 3 - **Guidelines for the Establishment of Airspace Structures** - provides guidance and identifies general principles for the establishment and use of airspace structures.

Section 4 - **Guidelines for ATS Route Network Development and Sectorisation** describes the general criteria used for the development of the European ATS Route Network (ARN) and associated airspace sectorisation.

Section 5 - **Guidelines for Terminal Airspace Design** - provides a methodology and identifies principles associated with Terminal Airspace design.

Section 6 - **Guidelines for Delegation of Airspace and/or ATS** - provides initial guidance for the Delegation of Airspace and/or Air Traffic Services.

Section 7 - **Guidelines for Free Route Airspace Design** - provides initial guidance material for the design of Free Route Airspace over a group of States.

Section 8 - **Terms and References** - provides a list of acronyms and abbreviations, as well as an explanation of terms and a list of references and source documents used to develop the manual.

1.2 PURPOSE

1.2.1 Need for an ECAC AIRSPACE PLANNING MANUAL

1.2.1.1 In order to reconcile contrary requirements in airspace utilisation between Commercial Aviation (*highest possible protection from other airspace users*), General Aviation & Aerial Work (*maximum freedom in all airspace*) and Military Aviation (*highest possible flexibility, freedom of access to all airspace, protection for special activity and low altitude flying*), airspace design and allocation is often a compromise between all expressed requirements and lead usually to lengthy discussions between the parties concerned. Therefore, in order to ensure more transparency and predictability of airspace management measures, it is necessary to establish within each State objective criteria for the design of airspace.

1.2.1.2 As identified in the EUROCONTROL Airspace Strategy for the ECAC States, there is now a strong need to evolve to a more collaborative airspace management at international level to ensure harmonisation of airspace organisations between all ECAC States. To that end, it is necessary to first establish an "ECAC AIRSPACE PLANNING MANUAL", which would provide guidelines and criteria for a uniform airspace design and change process for ECAC States to be mirrored in their own national Airspace Guidance Material.

1.2.2 Relationship with other Airspace-related Documents

1.2.2.1 The material in this document is intended to supplement the provisions specified in ICAO documents and in the Flexible Use of Airspace Reference Documents and it should therefore be used in conjunction with these documents.

1.2.3 Management of the Document

1.2.3.1 It is anticipated that the Airspace & Navigation Team (ANT) will be responsible for the maintenance of the Planning Manual and for monitoring the progress of its adaptation into national Guidance Material.

1.2.3.2 As it is intended that this Planning Manual should also reflect, in consolidated form, best practices and collective experience gathered in the field of airspace design, ECAC States, International Users Organisations and ATS Providers, all are encouraged to provide EUROCONTROL with their comments and suggestions for modification and/or extension to cover new aspects of airspace planning.

1.3 SCOPE

1.3.1 General

1.3.1.1 The scope of the ECAC AIRSPACE PLANNING MANUAL is that which was defined by the EUROCONTROL Airspace Strategy for the ECAC States. It is concerned with the needs of all airspace user groups on a basis of equity. Consequently, an important goal of the common guidelines for airspace design in the ECAC area described in this Planning Manual is to enable equal access to the airspace providing maximum freedom for all users consistent with the required level of safety in the provision of ATM services, while making due allowance for the security and defence needs of individual States.

1.3.1.2 The evolution of the ECAC airspace structure will follow closely the strategic principles and objectives of the ATM 2000+ Strategy. Due account will be taken of the increasing need for the provision of a seamless ATM service and the associated requirements for the interoperability between civil and military systems.

1.3.2 Applicability

1.3.2.1 Early material contained in this first (provisional) edition should not only be used as guidance by States in the continued development of their own national airspace planning process, but should also serve already as a basis for bilateral or multilateral discussion with their neighbours aiming at the harmonisation of their planning activities.

1.3.2.2 To that end, it should be clear that provisions contained in the EATMP Volume 2 have to be applied as from the time of its publication. Therefore, the first (provisional) edition only addresses agreed principles, criteria and/or guidelines currently in force or about to be decided such as common ATS Class above a common agreed level.

1.3.3 Institutional Framework

1.3.3.1 (see Volume 1)

1.4 SPECIFIC REMARKS RELEVANT TO THE FIRST EDITION

1.4.1 Provisional Edition

1.4.1.1 The drafting of the document entails gathering existing material and best practices, and also the production of new common guidelines. It was agreed that to enable early use of the document, in particular for the harmonisation of ATS Airspace Classification in all ECAC Airspace (Volume 2 - Section 2), a first (provisional) edition of the Planning Manual should be prepared and issued, as soon as possible.

1.4.1.2 Production of Volume 1 as well as completion of other Sections of Volume 2 will be made later on once developed by designated "sponsors" under the auspices of the Airspace & Navigation Team (ANT).

1.4.2 Complete Version

1.4.2.1 It is intended that this first (provisional) edition of the Planning Manual be replaced by a second (more complete) edition in about one year.

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SECTION 2

GUIDELINES FOR ATS AIRSPACE CLASSIFICATION

2.1 INTRODUCTION

2.1.1 Backdrop

2.1.1.1 The initial goal of ICAO in implementing in 1992 a new ATS Airspace Classification[1] was to simplify the airspace designation and to standardise equipment and pilot requirements for IFR and VFR operations. The purpose was to eliminate much of overlapping airspace confusion between CTA, CTR, TMA, ATZ,... and to clarify services provided to IFR and VFR flights in each class of airspace.

2.1.2 Current ICAO Requirements for Classification of ATS Airspace

2.1.2.1 According to ICAO Annex 11 - 2.5, when it has been determined that air traffic services will be provided in particular portions of the airspace or at particular aerodromes, then those portions of the airspace or those aerodromes shall be designated in relation to the air traffic services that are to be provided.

2.1.2.2 ATS airspace shall be classified and designated in accordance with the seven classes (A to G) defined in ICAO Annex 11 - 2.6. The requirements for flights within each class of airspace are defined in ICAO Annex 11 - Appendix 4 in terms of type of flight allowed, separation provided, services provided, meteorological conditions, speed limitations, radio communication requirements and ATC clearance given.

2.1.2.3 States shall select those airspace classes appropriate to their needs from the less restrictive Class G to the more restrictive Class A.

2.1.3 Differences Notified to ICAO

2.1.3.1 ICAO provisions were interpreted in different ways by the ECAC States to best meet their own national requirements. Some States have therefore notified differences between their national regulations and practices and the corresponding International SARPS to ICAO. Other States have even not yet introduced ATS Airspace Classes.

2.1.3.2 Some ECAC States authorise VFR flights above FL 195, either by establishing Class B or C, or by allowing VFR flights in Class A in accordance with specific conditions and/or with special ATC instructions. Some States relieve IFR flights from mandatory requirements for continuous two-way radio communication in Classes F & G. Other States do not permit IFR flights in Class G. Another State requires ATC clearances for IFR flights to operate in Class F airspace.

2.1.3.3 Most of the States have adapted VMC minima to their national conditions. Some States provide ATC service to VFR flights or at least separation from IFR.

[1] Reference: Third Meeting of the Visual Flight Rules Operations Panel [VFOP] (1986)

2.1.4 Need for a Simplified and Harmonised Airspace Organisation

2.1.4.1 The EUROCONTROL Airspace Strategy for the ECAC States has clearly identified a lack of harmonisation in current application of ICAO ATS airspace classification by the ECAC States.

2.1.4.2 Therefore, the Airspace Strategy calls for a uniform application of these classes appropriate for the traffic operating in the airspace in order to avoid over and under classification. In addition, classifications should be as simple as possible and should also permit unambiguous rules and safe flight operations.

2.1.4.3 Direction for Change [A] of the Airspace Strategy identifies the strategic steps towards a simplified airspace organisation based on the proposed Traffic Environment Model (N, K, U). The two first steps refer to the harmonisation of ICAO airspace classification in all ECAC airspace starting with a common classification of Upper Airspace above a common agreed level.

2.1.4.4 To that end, common criteria/parameters for the classification of the various different types of airspace (e.g. UTA, CTA, CTR, TMA, AWY, UIR, FIR,...) are defined in the present Section 2.

2.2 AIR TRAFFIC SERVICES REQUIREMENTS

2.2.1 Requirements for Civil ATS Provision

2.2.1.1 To cope with the continuing increase in IFR traffic, ECAC States have progressively reduced the use of non-radar procedures by the introduction of appropriate radar and communications systems with a sufficient level of automation so as to improve ATC capacity and efficiency as well as to enhance safety.

2.2.1.2 Functional compatibility of the data exchanged between the airborne and the ground elements is essential to ensure the efficiency of the overall ATM system. An air traffic control unit shall therefore be provided with information on the intended movement of the aircraft, or variations therefrom, and with current information on actual progress of the aircraft, so as to determine from the information received, the relative position of known aircraft to each other.

2.2.1.3 In order to meet the aspirations of the users of the airspace in the context of enhancing the flexibility of operations, whilst maintaining a safe and orderly flow of air traffic, the organisation of the airspace will need to evolve to an airspace structure based on the knowledge of traffic. The level of control will then be determined by the complexity of the traffic situation rather than on the current system of airspace classifications.

2.2.2 Requirements for Military ATS Provision

2.2.2.1 Military flying operations constitute a significant and important proportion of total airspace use. Therefore, the military authorities of some ECAC States have established their own "Operational Air Traffic" (OAT) Services in parallel with the "General Air Traffic" (GAT) services system in order to provide for their specialised operations such as air combat training, low-level missions, in-flight refuelling and high-energy flying activities which are incompatible with normal application of the ICAO Rules of the air and air traffic services procedures.

2.2.2.2 As co-existence of civil and military ATS systems has, in many cases, resulted in competition and an inefficient use of airspace, some States have decided to create an integrated ATS system to provide for both the civil and military needs. Experience gained by these States seems to indicate that this solution offers promising results regarding the equitable and efficient sharing of airspace.

2.3 COMMERCIAL AIR TRANSPORT REQUIREMENTS

2.3.1 General Requirements

2.3.1.1 In respect of airspace organisation, the airlines community seeks:

- Seamless services within airspace considered as a continuum;
- Simple and unambiguous rules, easy to implement and follow;
- Freedom of movement to follow preferred and flexible flight profiles with minimum constraints;
- Pan-European harmonisation of airspace structure and legislation;
- Upper/Lower Airspace classification should be harmonised as soon as possible in order to match the traffic operated in the airspace on an European network basis.

2.3.2 Requirement for a Clear Notification of Separation Responsibility

2.3.2.1 One of the main critical issues identified with the lack of harmonised application of ICAO ATS Airspace Classification is the limited awareness of aircrews regarding Airspace classes, the confusion about services offered and the lack of knowledge of separation responsibility in particular at lower levels, when airspace classification is constantly changing.

2.3.2.2 For example, with radar services provided for the most part of the flight throughout Europe, the flight crews operating on an IFR flight plan tend to think that separation from all other traffic is always provided by ATC regardless of the class of airspace in which they are operating.

2.3.2.3 Safety of commercial air transport being of paramount importance, active control with separation assured by ATC should therefore be the rule for normal IFR operations.

2.4 MILITARY OPERATIONS REQUIREMENTS

2.4.1 General Requirements

2.4.1.1 Security in Europe may necessitate military operations in the frame of actions taken by international organisations (UN, NATO, WEU,...), and for military aircraft to take precedence over civil aviation in some circumstances. It is, therefore, a fundamental principle that each ECAC State is able to train and operate its military air, sea and ground forces to enable them to discharge their responsibilities for security and defence. In order to carry out its operational tasks, military aviation seeks therefore:

- freedom to operate in IMC/VMC at any time in all areas of the ECAC airspace;
- special handling in particular for priority flights and for time-critical missions, but also for military aircraft not fully equipped to the civil standard;
- to retain the possibility of operating uncontrolled VFR flights, including in "Controlled" airspace;
- temporary airspace reservations (TSAs), to contain activities which are incompatible with normal application of the Rules of the Air;
- airspace restrictions for non flight-related activities such as protection of areas of national interest, gunnery, missile firing, etc....

2.5 GENERAL AVIATION & AERIAL WORK OPERATIONS REQUIREMENTS

2.5.1 General Requirements

2.5.1.1 General Aviation (GA) requires access to controlled airspace and airports at reasonable commercial cost, their increased activity is likely to be largely centred on less congested airports. Aerial Work (AW) aviation needs to reserve airspace for particular operations, while recreation and sports aviation operating under VFR require a legitimate right of access to European airspace, but may not be able to fit a multitude of different equipment to their aircraft.

2.5.1.2 Although the majority of GA/AW flights operate in "Lower" Airspace under VFR rules, a sizeable amount (more than 10%) is IFR traffic. Therefore, the General Aviation & Aerial Work community seeks:

- to achieve maximum freedom of movement in all categories/classes of airspace;
- sufficient "Uncontrolled" airspace and VFR access to "Controlled" airspace, in particular for some gliders in the "Upper" Airspace;
- to maintain the right to change flight rules from IFR to VFR and vice-versa in the air, as well as before landing or after take-off or, at least, to receive special handling;
- to have the possibility of operating under VFR as long as weather conditions permit the application of the "see and avoid" rule.

2.6 TEST FLIGHTS & UAV OPERATIONS REQUIREMENTS

2.6.1 General Requirements

2.6.1.1 Test and Acceptance Flights for both civil and military purposes require special handling, but represent a relatively small airspace user community. The use of Uninhabited Aerial Vehicles (UAVs), formerly developed for military operations and recreation (model flying), has recently been extended to various civil aerial applications as a more cost effective solution than the use of conventional aircraft or helicopters.

2.6.1.2 No uniform regulatory framework for UAVs exists as of today, but it could be assumed that the Test Flights & UAVs community seeks mainly:

- accommodation of their operations, based on shared use of airspace, with sometimes a need for special handling, rather than on strict segregation;
- possibility of operating in the "Upper" Airspace;
- definition of standards for additional equipment capabilities so that UAVs can be designed to achieve compatibility with the airspace they are expected to operate in.

2.7 LIST OF POTENTIAL CRITERIA TO ESTABLISH CLASSIFICATION

2.7.1 General

2.7.1.1 In the course of evolution of ECAC airspace towards a simplified organisation as identified in the Direction for Change [A] of the EUROCONTROL Airspace Strategy for the ECAC States, the different options/classes available for the airspace classification will be limited to those currently defined in the harmonisation process in force at the time of publication of the present Edition/Amendment of the Planning Manual.

2.7.1.2 Due to the number of elements involved, it has not been possible to develop specific criteria to determine how to classify the airspace in a given area or at a given location. However, taking into account best practices in use in some ECAC States, the following decision-making criteria could be considered :

- Level of Air Traffic Services to be provided;
- Air safety-relevant incidents;
- IFR traffic volume;
- Mixed environment (IFR/VFR flights, different speeds and/or types of aircraft,...);
- Traffic concentration - Environmental Constraints;
- Particular operations (Military, GA, Test Flights, Aerial Work, Gliders, UAV,...);

- Meteorological conditions - Daylight/Night Operations;
- Flight Planning Issues;
- Cost-Benefit Analysis (Staff training, mandatory equipment, user charges,..).

2.7.2 Level of Air Traffic Services To Be Provided

2.7.2.1 Basically, when the number and frequency of IFR traffic have reached a level where the responsibility for the arrangements to maintain a safe and expeditious flow of traffic can no longer be left to the discretion of individual pilots, the provision of Air Traffic Control (ATC) will be required. This shall apply in particular when IFR operations of a commercial nature are conducted.

2.7.2.2 The planning for and the execution of ATC is essentially a national responsibility. However situations may arise where States will be required to improve their services, not because there is an urgent national requirement to do so, but in order to ensure that adjacent States, being confronted with such needs, are not deprived of the benefits of their efforts.

2.7.2.3 It is, therefore, of prime importance that both the planning and execution of ATC is conducted in a manner that ensures that optimum uniformity is maintained to the largest possible extent. Thus, the delineation of airspace, wherein ATC is to be provided, should be related to the nature of the route structure and/or the containment of IFR flight paths and also to the need for efficient service rather than to national boundaries (see Section 3).

2.7.3 Air Safety-Relevant Incidents

2.7.3.1 Even though airspace classification should be established mainly as a preventative measure to avoid aircraft proximity, a local concentration of Air Safety-Relevant Incidents will require an immediate overall situational analysis which might lead to a change of class in the airspace concerned.

2.7.4 IFR Traffic Volume

2.7.4.1 Categorisation of airspace surrounding aerodromes is mainly influenced by the volume of IFR traffic to be handled. As the number of IFR take-offs and landings at an aerodrome increases, the necessity to protect IFR operations from other traffic by implementation of a more restrictive ATS Class may be appropriate.

2.7.4.2 Change in airspace classification would therefore be considered primarily on the basis of the IFR traffic figures and trends registered over previous years and forecast increases or decreases at a given aerodrome. To that end, in order to simplify airspace organisation, modular airspace structures with a limited number of ATS Classes in accordance with the Airspace Strategy would be associated to different categories of aerodromes in accordance with their annual IFR traffic volume.

2.7.5 Mixed Environment

2.7.5.1 A mixture of different types of air traffic (IFR/VFR) with aircraft of various speeds (light, conventional, jet, etc...) necessitates the provision of more advanced air traffic services and the establishment of a more restrictive class of airspace than for example the handling of a relatively greater density of traffic where only one type of operation is concerned.

2.7.5.2 Therefore, qualitative data on issues related to the handling of a mixture of traffic should be gathered to assess the best classification for a given block of airspace. The following parameters could be considered: proportion of jet and/or heavy aircraft, amount and type of VFR operations, training activities.

2.7.6 Traffic Concentration - Environmental Constraints

2.7.6.1 Areas of intense activity, flight paths of both IFR and VFR traffic, traffic flows (*uni-, bi- or multi-diectional*), the relative situation of aerodromes in the vicinity, the proximity of big cities, etc... are other qualitative criteria which may influence the choice of an ATS class in order to ensure the degree of control required to manage the situation.

2.7.7 Particular Operations

2.7.7.1 In determining an ATS class appropriate for the main user of a block of airspace, care should be taken that unnecessary restrictions are not imposed on other traffic such as Military, General Aviation, Test Flights, Aerial Work, Gliders and/or UAV wishing to operate in this airspace.

2.7.7.2 To that end, special handling, procedures, "corridors/windows" and/or "transit" routes should be defined where appropriate, to facilitate the operations of these other users.

2.7.8 Meteorological Conditions - Daylight/Night Operations

2.7.8.1 Meteorological conditions and/or Daylight/Night operations might have a substantial effect on the ATS classification of areas where there is a regular flow of IFR traffic, whereas similar or worse conditions might be less important for the classification of an area where in any case such conditions would suspend accustomed VFR traffic.

2.7.8.2 Most of the ECAC States have therefore adapted VMC minima to their prevailing national weather conditions. However, in view of the simplification and harmonisation of ATS Classification in Europe, adoption of common VMC minima for all the ECAC region should be sought.

2.7.9 Flight Planning Issues

2.7.9.1 The flight plan is currently the only way by which the pilots/operators inform ATS of their intended operations and formally request associated services. From the flight plan ATS derives all information of operational significance regarding the intended flight, such as equipment carried, route to be flown, requested flight level(s), departure/destination aerodrome, etc...

2.7.9.2 When it becomes necessary for ATC to have available all of this information on each individual aircraft operating within a given volume of airspace, a change in airspace classification may be required in order that mandatory filing of flight plans is established.

2.7.10 Cost-Benefit Analysis

1.4.2.2 Change in airspace classification may have an impact as regards staffing and training of qualified personnel (pilots & controllers), which usually require advance planning and therefore consideration during the decision-making process.

2.7.10.1Change in airspace classification may also require the provision of additional means and facilities, especially for communication, navigation and surveillance. RNAV and RVSM capabilities as well as transponder equipment may be mandatory requirements in some classes and such requirements need therefore to be considered at an early stage in the decision-making process.

2.7.10.2Changes in airspace classification may therefore depend on a comprehensive Cost-Benefit Analysis.

2.8 GUIDANCE FOR ORGANISING THE "UPPER" ECAC AIRSPACE

2.8.1 Common Agreed Classification of the "Upper" Airspace over ECAC

2.8.1.1 Within the Upper ECAC Airspace, the types and density of traffic at any moment above FL 195 require provision of ATC to all traffic with common procedures.

2.8.1.2 An ATS Route Network (ARN) has thus been established in the Upper ECAC Airspace, under the auspices of the EUROCONTROL Airspace & Navigation Team (ANT), for the purpose of flight planning and which facilitates the organisation of an orderly traffic flow by the Central Flow Management Unit (CFMU) [*see Section 4*].

2.8.1.3 Area-type control arrangements in place in most of ECAC States in the Upper airspace have the advantage that whenever traffic conditions and military activities permit, ATC may authorise specific flights under its control to deviate from the established route structure and to follow a more direct flight path or to fly in parallel with other flights without aircraft leaving controlled airspace and thus losing the benefit of ATC.

2.8.1.4 ECAC States have therefore commonly agreed to provide, as from **(TBD)**, an area-type control service in all the ECAC airspace ***above FL(X) in Class (TBD)***.

2.8.2 Common Process for ATS Airspace Classification in the Upper Airspace

2.8.2.1 ECAC States shall designate the authority responsible for providing ATC services within the corresponding block of airspace under their sovereignty and for the territories over which they have jurisdiction. Those States still using interconnecting airways with specified lateral limits would be expected to change to an area-type control arrangement above FL 195.

2.8.2.2 In order to ensure a common ATS airspace classification in the Upper ECAC Airspace in accordance with the Airspace Strategy, ECAC States are required to re-organise the upper airspace and associated traffic handling to the extent necessary to implement the general agreements recalled above in paragraph 8.1.4. To that end, ECAC States will:

- formalise in a regional air navigation agreement the establishment of a common ATS Airspace classification.
- enact this international agreement in corresponding national Regulations and/or Decrees;
- update accordingly their national AIP.

2.8.3 Common Conditions for Providing ATC to VFR Operations in the "Upper" Airspace

2.8.3.1 TBD

2.9 GUIDANCE FOR ORGANISING THE "MIDDLE" ECAC AIRSPACE

2.9.1 Need for a Known Traffic Environment above a common division level

2.9.1.1 TBD

2.9.2 Classification of a System of ATS Routes

2.9.2.1 TBD

2.9.3 Classification of a Control Area (CTA/TMA)

2.9.3.1 TBD

2.9.4 Special Handling of Particular Operations

2.9.4.1 TBD

2.9.5 Common Process for ATS Airspace Classification in "Middle" Airspace

2.9.5.1 TBD

2.10 GUIDANCE FOR ORGANISING THE "LOWER" ECAC AIRSPACE

2.10.1 Categorisation of Airspace Surrounding Aerodromes

2.10.1.1 TBD

2.10.2 Evaluation of VFR/IFR Traffic Mix and Concentration

2.10.2.1 TBD

2.10.3 Impact of Daylight/Night Operations and/or Weather Conditions

2.10.3.1 TBD

2.10.4 Classification of Terminal Airspace

2.10.4.1 TBD

2.10.5 Special Handling of Particular Operations

2.10.5.1 TBD

2.10.6 Common Process for ATS Airspace Classification in "Lower" Airspace

2.10.6.1 TBD

2.11 RATIONALISATION OF ATS AIRSPACE CLASSIFICATION TOWARDS TRAFFIC ENVIRONMENT MODEL - (SEE ANNEX A) -

2.11.1 Concept of iNtended Traffic Environment (Category N)

2.11.1.1 TBD

2.11.2 Concept of Known Traffic Environment (Category K)

2.11.2.1 TBD

2.11.3 Concept of Unknown Traffic Environment (Category U)

2.11.3.1 TBD

2.11.4 Separation Responsibility (ATC or Visual)

2.11.4.1 TBD

2.11.5 ATS Provision

2.11.5.1 TBD

2.11.6 Common Differences Notified to ICAO

2.11.6.1 TBD

2.11.7 Common Process for Airspace Categorisation in N, K, U

2.11.7.1 TBD

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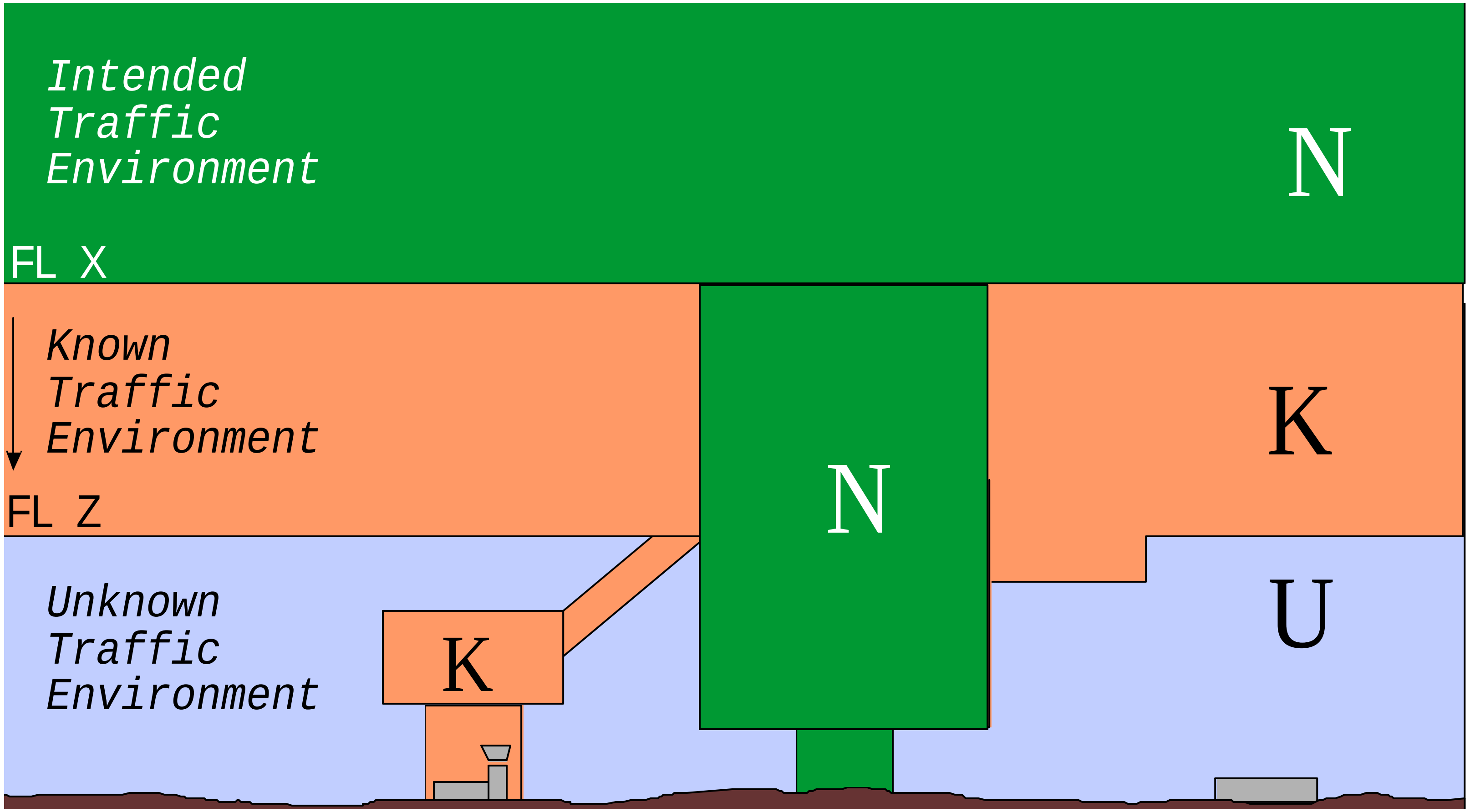
Annex 2A

RATIONALISATION OF ATS AIRSPACE CLASSIFICATION



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SECTION 2

GUIDELINES FOR ATS AIRSPACE CLASSIFICATION

FINAL PAGE

SUGGESTION - COMMENTS

To report any errors, or to propose a modification to the present Section 2 "Guidelines for ATS Airspace Classification", please contact:

Mr Bill Armit
EUROCONTROL
Airspace Management & Navigation Unit (AMN)
Rue de la Fusée, 96
B-1130 BRUSSELS
(E-mail: bill.armit@eurocontrol.int)

SECTION 2 - SPONSOR: AIRSPACE MANAGEMENT SUB-GROUP

Whenever material received, in accordance with the above procedure, makes it apparent that an amendment of the present Section 2 is required, such amendment will be first discussed within the Airspace Management Sub-Group (ASM-SG) before its adoption by the Airspace & Navigation Team (ANT).

PUBLICATION OF AMENDMENT

The agreed amendment will then be issued by EUROCONTROL in the form most convenient for its insertion in the Planning Manual.

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SECTION 3

GUIDELINES FOR THE ESTABLISHMENT OF AIRSPACE STRUCTURES

3.1 INTRODUCTION

- TO BE DEVELOPED -

UNDER THE SPONSORSHIP OF ASM-SG

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SECTION 4

GUIDELINES FOR ATS ROUTE NETWORK DEVELOPMENT AND SECTORISATION

4.1 INTRODUCTION

4.1.1 General Approach

Since 1993 under the auspices of the Airspace & Navigation Team (ANT), the Route Network Development Sub-Group (RNDSG) has developed a planning process for versions of the ATS Route Network (ARN) which is "Top Down" and utilises a number of facilitating concepts and planning techniques which are described in the following sections.

4.1.2 A "Top Down" Approach

In developing versions of the ARN, the RNDSG has, as already mentioned, adopted a "Top Down" Approach which takes an ECAC wide view and is based upon the need for enhancement of overall ECAC ATM capacity. The process includes progression from broad proposals towards specific solutions.

Step 1 - Starting from in-depth analysis to identify current and foreseen problems, the planning work should highlight the actual causes of the weak links in the airspace structure.

Step 2 - Based on agreed general principles and criteria, the planning work should build overall route proposals to accommodate major traffic flows reducing the airspace structure complexity and balancing the ATC workload.

Step 3 - Within this defined framework, detailed proposals of airspace structure should be elaborated, consolidated and validated through appropriate regional expert groups.

The result of local studies must feed back into the initial proposals in a dialectical and iterative process.

Step 4 - A phased implementation programme must be agreed before coming into force.

A schematic diagram of the Top Down Approach is given in Annex 4.

4.1.3 Planning Principles (PP)

Versions of the ARN are developed on a number of agreed planning principles.

They are:

PP 1 - **Planning should take into account the needs of both civil and military airspace users.**

PP 2 - **Planning should normally expand from the core to the periphery.**

It is well recognised that the question of ATM en-route capacity in ECAC airspace is essentially a problem of airspace capacity in the core area. Therefore, the architecture of the network should normally be developed from the core area toward the periphery by building the structure upon the most heavily loaded intra-European routes linking the top origin/destination areas. However, in applying this principle the specific problems of the periphery, such as ATM capacity, transition tasks etc, should be taken into account.

PP 3 - **Planning should 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 interrelationship between the network's structure and sectorisation definition. Consequently, from the initial planning phase onwards, it is necessary to ensure that a proper sectorisation scheme, in-
cluding ATS delegation is feasible and viable in relation to the planned network.

PP 4 - **Planning should integrate into the en-route network, transition routes to/from TMAs in the initial planning phase.**

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

PP 5 - **Planning of ATS routes should aim at enabling a majority of flights to operate along or as near as possible to the direct route from origin to destination.**

Network development should 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.

PP 6 - **Planning of ATS routes should be in accordance with relevant ICAO Standards and Recommended Practices (SARPS).**

4.1.4 Facilitating Concepts (FC)

FC 1 - **B-RNAV as the primary concept of navigation**

Airspace planning should be based on a BRNAV navigation system (not constrained by the location of station referenced navaids).

Note:

With effect from 1998, the EATCHIP Programme proposed that the carriage of B-RNAV equipment, approved for RNP-5 operations, would become mandatory for non-State aircraft on the entire ATS route network in the ECAC area, including designated feeder (transition) routes (SIDs & STARs) in/out of notified TMAs. States may designate domestic routes within the lower airspace as available for aircraft not fitted with RNAV.*

FC 2 - **Full application of the FUA concept and extension to civil/civil flexibility through additional optional routeings.**

In application of the Flexible Use of Airspace concept, conditional routes should be planned to reinforce the permanent ATS route network based on pre-defined utilisation scenarios compatible with operationally efficient sector configuration.

The establishment of CDRs should be supported by the generalisation of area type controlled airspace.

FC 3 - Route network planning in ECAC airspace should take place in a seamless way, disregarding 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:

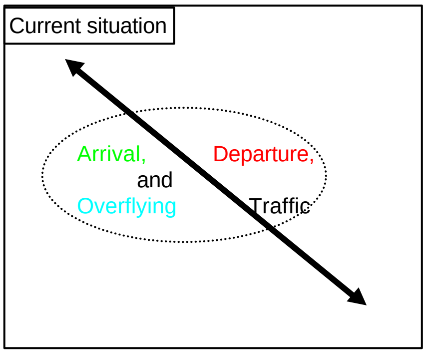
- when alignments of routes drawn independently of FIR boundaries determine the location of crossing points close to existing FIR/sector boundaries, in order to provide the controller with sufficient anticipation with respect to entering traffic;
- when alignments of routes affect an FIR airspace for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

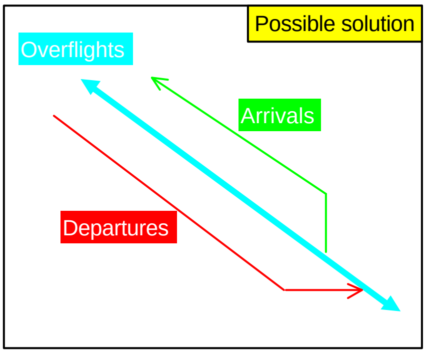
FC 4 - As from Version 4, maximise the capacity enhancement potential of RVSM implementation on 24th January 2002.

4.1.5 Planning Techniques (PT)

PT 1 - Establish specialised routes.

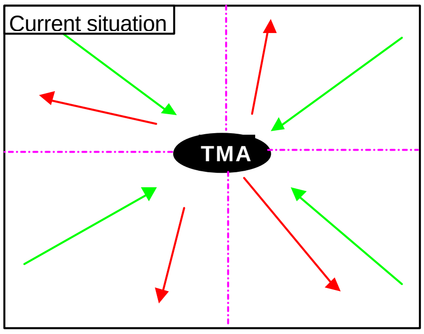
In dense areas, additional capacity can be gained by the segregation and deconfliction of arrival/departure routes and their separation from overflight routes. This structure should be applied for climbing and descending phases.

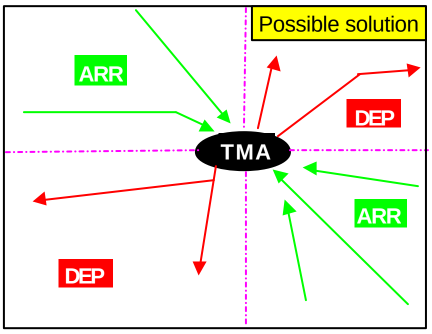




PT 2 - Establish specialised sectors.

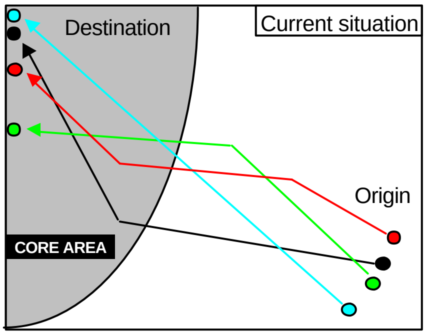
Based on the structure described above, specialised sectors should be established, grouping sets of routes of similar nature (arrival/departure; see illustration below), direction, and/or flight level series (odd level specialised sector, even level specialised sector). Where practicable, sectors should be specialised to solve one main specific problem.

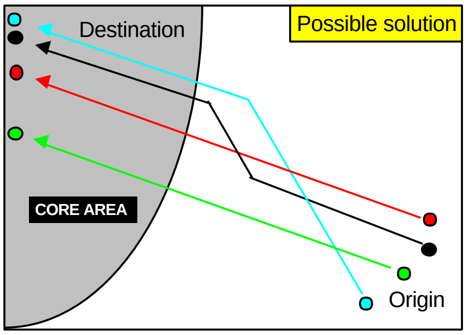




PT 3 - Organise any essential crossing of ATS routes carrying major traffic flows as close as practical to their origin.

Network development should be done in such a way that any essential crossing of ATS routes carrying major traffic flows can be carried out as close as possible to their origin. However, taking into consideration the network complexity in the vicinity of the origin area, it may be more appropriate to transfer the crossing into areas where the network/traffic density is lower.





4.2 CRITERIA FOR DEVELOPING A NEW VERSION OF THE ARN

4.2.1 General

In developing Version 3 of the ARN, the RNDSG produced a comprehensive list of criteria applicable to both route network and sector development. These were included in a separate document as a deliverable in the EATCHIP programme: doc ASM.ET1.ST02.Del01. This deliverable was endorsed by the ANT in October 1997. As this work is still applicable in general terms to the development of routes and sectors, and as the time available to the RNDSG, did not allow a review of this work before the commencement of the development process for Version 4, it was agreed that the Version 3 criteria would continue to be the basis for Version 4, supplemented by specific criteria applicable in the context of RVSM Implementation.

4.2.2 Overview of Criteria used for Route Network and Sectorisation Development

The general criteria used for route network and sectorisation development, as drawn up for Version 3, are included as Annex A and Annex B. These general criteria are now complemented by the Guidelines developed as a result of the simulations and evaluations carried out to assess the impact of RVSM in an Airspace context. These EUR RVSM Implementation guidelines are summarised in section 2.3.

4.2.3 Summary of Specific RVSM Criteria for Version 4

The implementation of RVSM will alter the vertical distribution of traffic as extra flight levels become available for use and the density of traffic on each flight level reduces. This should enable more aircraft to fly at, or close to, their optimum FL and permit a relaxation of the level capping restrictions on short haul city pairs. In order to manage this change in vertical distribution it will be necessary, where traffic levels dictate, to re-evaluate the Division Flight Level (DFL) between sectors based on 500ft intervals.

The criteria applicable to sector development is common to both core EUR RVSM and EUR RVSM Transition Airspace. Changes to the vertical dimension of sectors within Transition airspace are not considered necessary for RVSM implementation, but States may take this opportunity to evaluate the feasibility of introducing a DFL. In this case the possible increase in the climbing and descending traffic close to FL 290 should be taken into consideration.

Within the core EUR RVSM airspace the change in DFL should be based on operational needs and should:

- result from the ‘natural’ vertical traffic distribution rather than ‘force’ traffic to fit in with the vertical sector design.
- consider all airspace from ground to unlimited (including lower airspace) when planning the DFL.
- seek to balance the traffic loads between layers, avoiding unnecessary vertical co-ordination between the sectors.

The criteria for route network development includes specific guidance for Transition Airspace where route structure solutions involving uni-directional routes or Flight Level Allocation Schemes, ease the Transition Task in sectors where traffic levels warrant a structural solution. The increased use of uni directional and specialised routes for segregating and integrating departure traffic with overflying routes, is also valid in core EUR RVSM airspace.

The design and application of a FLAS is complex and the studies have shown that it should be designed using common planning principles, which avoid possible conflict over the choice of FLs on individual routes and permit extension if required. The selection of the preferred/blocked FLs should be kept to a minimum, be co-ordinated along the length of a route and be made according to a global rule in order to avoid frequent changes in FL. Although the FLAS options tested in the simulations were not advantageous to the ATS system as a whole there are instances where the controller workload can be reduced through its application. Therefore, it is recommended that the application of FLAS be restricted to major confluences and crossing points within EUR RVSM airspace and, when a route network solution cannot be found, to route segments close to the EUR RVSM/non-RVSM boundary in Transition Airspace.

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Annex 4A

(Extract from "Concept and Criteria for Medium Term EUR Route Network and Associated Airspace Sectorisation")

1. GENERAL CRITERIA FOR ATS ROUTE NETWORK DEVELOPMENT

1.1 Basic Structure

A network of ATS routes should form the basis for the determination of the airspace organisation and the required air traffic services and facilities. It should be so established as to enable a majority of flights to operate along, or as near as possible to, the direct route from point of departure to destination.

Region-wide ATS route structures should be set up along broad alignments joining major origin/destination areas. These alignments must be structured in an operationally viable way.

In order to achieve optimum ATM capacity there may be a need for non-optimum flight levels and routeings.

The restructuring of the ATS Route network should be performed in an evolutionary manner. As the restructuring of entire portions of the airspace, e.g. a major traffic axis, is agreed, implementation should not be delayed whilst waiting for the plans for restructuring of additional portions to be completed. States may need to ensure, where they cannot accept proposals being made, that they present an alternative.

1.2 International Planning

The process should provide States with an internationally agreed broad and basic concept of the airspace and ATS Route structure in the ECAC area serving as a basis for national or regional planning.

States should plan major changes of their airspace and ATS Route structure affecting the basic ATS Route Network with prior co-ordination and exchange of information with the largest possible number of international parties concerned. This should be carried out well in advance and preferably in multilateral fora.

1.3 Relationship between Network and Sectorisation

There is a close two-way inter-relationship between the network's structure and sectorisation. Consequently, from the planning phase onwards, it is necessary to ensure that a sectorisation scheme, including possible delegation of ATS, is feasible and viable in relation to the planned network. In particular, the definition of the directions of use on the uni-directional routes, as well as the final alignment of these routes may have to be adapted in consideration of sectorisation efficiency. This could be validated through simulations.

1.4 Civil/Military Interface

Civil/Military co-operation related to the more efficient and flexible use of airspace should be applied on as wide a scale as possible along the principles of the FUA Concept.

1.5 Extension of the FUA concept

Extension of the FUA concept to additional direct routeings should be made available under pre-defined civil/civil conditions (Staffing/sectorisation/traffic density). This would mean the extension to larger airspaces (groups of sectors/ACCs) of the current tactical ATC practice of direct routeings which is today generally applied within one sector. The automated reprocessing of flight plans would facilitate the further application of this concept.

1.6 Network Architecture

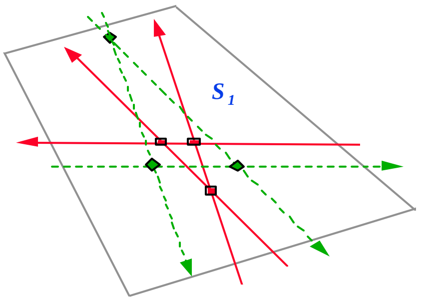
The definition of major traffic flows should include heavily loaded intra-European routes and/or segments which should be integrated in the overall structure at an early stage of the planning.

The architecture of the network should normally be developed from the core area towards the periphery.

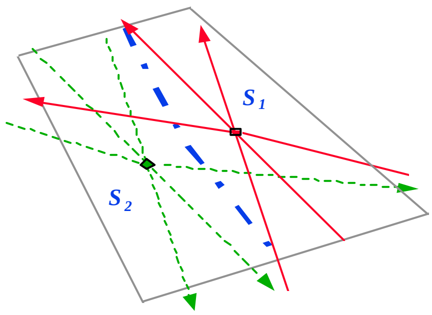
Efforts to eliminate specific traffic bottlenecks should include, as a first step, an in-depth analysis of the factors causing the congestion. In this regard, particular care should be taken to avoid worsening the situation in one area by attempting to improve it in the other.

“Roundabout[2]” network structure should be conceived to fit with specific sectorisation and to allow the splitting of multiple crossings into different sectors.

[2]In the context of complex multiple crossing points, “Roundabout” means the grouping of uni-directional routes of the same series of flight levels (odd and even) on to two different points (areas), thus separated one from the other, in order to allow the establishment of two different sectors and thereby achieving a spread of the workload.



Direct routeings :
Square shaped crossing points (even levels) and diamond shaped crossing points (odd levels) are complex and may result in an overloaded sector which cannot be split. (limited maximum capacity)



Structured routeings with “Roundabouts” :
The resulting location of the actual crossing points makes it possible to split the former sector into two sectors and enhance the maximum capacity.

The number of ATS Routes shall be kept to a minimum but should be in line with the traffic demand in respect of ATM capacity and most direct routeing.

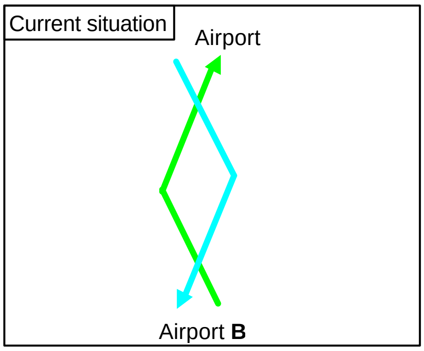
Although it is accepted that a large number of ATS routes can improve route capacity, it is also recognised that a large number of crossing points, especially in congested areas, can reduce sector capacity. Planners should optimise capacity by introducing new routes with as few crossing points as possible and these crossing points should be well clear of congested areas.

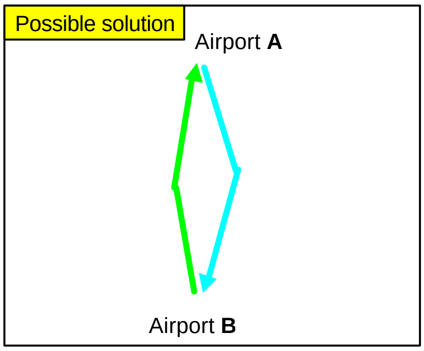
Whenever in the planning phase and based on forecast demand, an ATS route has been planned to accommodate a specific flow of traffic, its subsequent implementation should - if the traffic demand by that time is no longer met - be reconsidered. Redundant ATS routes should be deleted.

Use of uni-directional routes should be extended, particularly in areas where the interaction of climbing and/or descending traffic is a limiting factor, with the expected advantage that the improved structuring of the traffic would increase ACC Sector capacities.

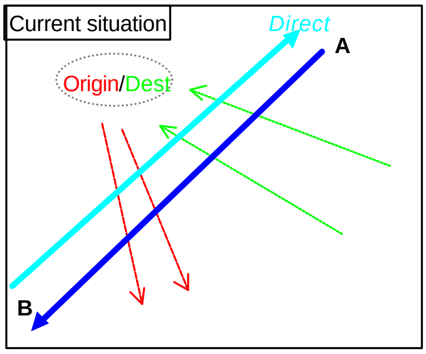
1.7 Planning of Routes

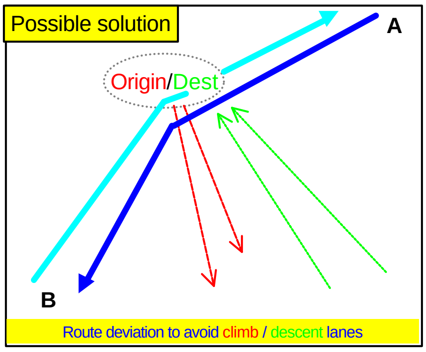
Planning should ensure that where dualised routes are used uni-directionally for opposite traffic flows, cross-overs are avoided as far as possible.



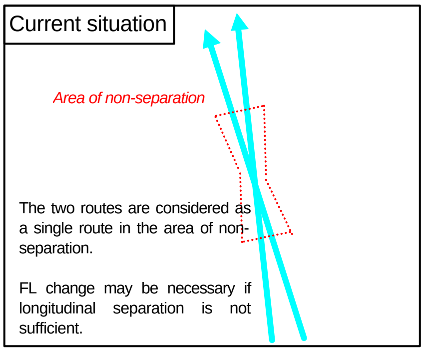


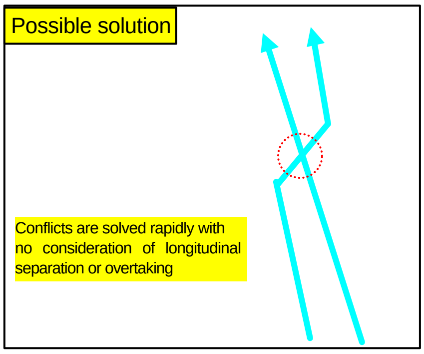
Crossing areas should not conflict with climb or descent lanes of major airports.



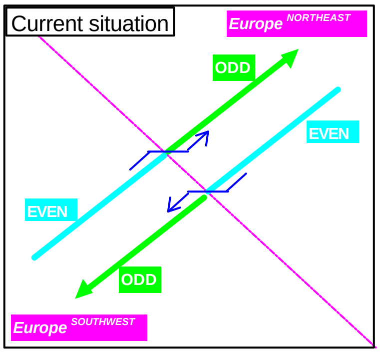


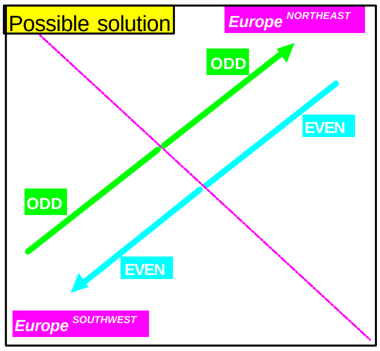
The extension of crossing areas between ATS Routes should be kept to a minimum (crossing at right angles).



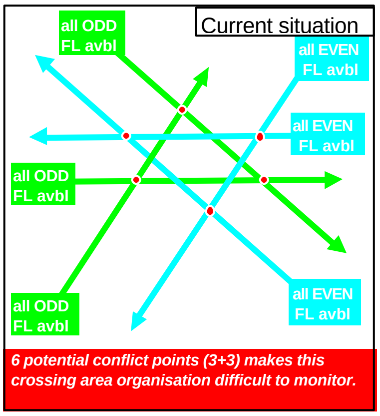


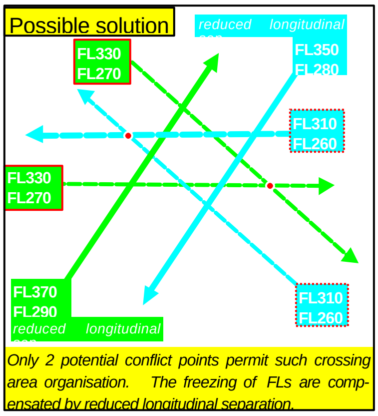
Currently two different applications of the ICAO table of cruising levels coexist in the EUR Region. This leads to a requirement for aircraft transiting the boundary between the two application areas to change flight levels. Consideration should be given to the possible increase of system capacity which would result from a less rigid application of the present method of segregation of eastbound and westbound flight levels. This is already practised in some “one-way” ATS routes.





It should be recognised that the definition of a given flight level allocation scheme will have a direct impact upon the way in which major crossing points will have to be organised.





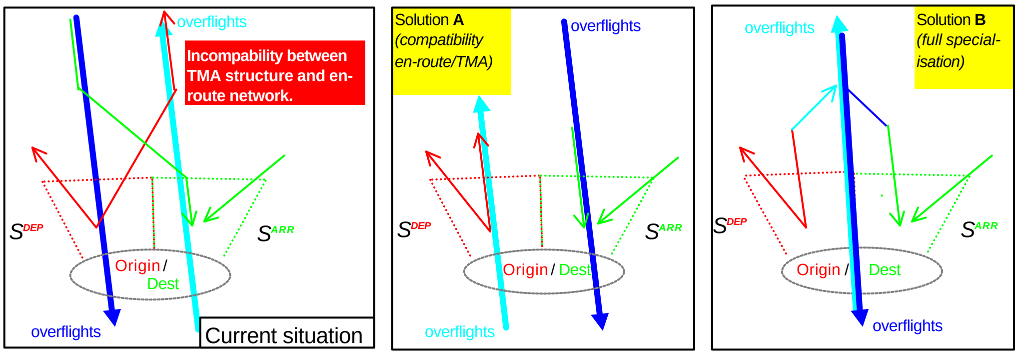
1.8 Shorthaul Routes and Levels

Specific routeing and/or flight level allocation for short haul city pairs may be established.

1.9 Transition* Routes

The traffic in the ECAC area is predominantly short haul traffic with nearly half of the flight distance spent in climb and descent phases. From the first stage of the network planning, it is therefore necessary to consistently integrate major transition* routes in the whole structure and to ensure TMA-Network interfaces compatibility *(see Solution A below)*. This is valid for the major origin/destination areas.

Fixed routes systems based on RNAV should, if necessary, be applied at airports with high traffic density to specialise arrival and departure routes. Such route systems (specialised routes) should be designed to enable arriving, departing and overflying traffic to be separated systematically, while seeking to permit economical flight paths *(see Solution B below)*. In order to optimise the use of airspace and aerodrome capacity route systems should be designed, where possible, to take account of different aircraft performance capabilities.



Annex 4B

(Extract from "Concept and Criteria for Medium Term EUR Route Network and Associated Airspace Sectorisation")

1 GENERAL CRITERIA FOR AIRSPACE SECTORISATION DEVELOPMENT

1.1 Introduction

At present many of the constraints in the ECAC ATM system are caused by a lack of adequate **sector capacity**. With traffic demand increasing steadily at average annual rates of 4 to 5%, it is clear that achievement of enhanced sector capacity is a crucial objective if congestion problems and their associated delays are to be minimised.

A number of studies and analyses have been carried out in Europe, which have identified the close interrelationship between sectorisation and route network configuration. Therefore, this relationship must be taken into consideration in planning the improvement of the ECAC ATM system. In particular, it is essential to ensure that route network and airspace sectorisation are coherent and compatible, if optimum capacity gains are to be realised. In particular, the planning of Version 3 incorporates this consideration.

1.2 Method/Rationale

In developing the optimum airspace structure the RNDSG has adopted a Top Down or overall ECAC wide approach (see paragraph 3.1). This approach is an outcome of the following rationale.

FIR boundaries which are mainly contiguous with State boundaries can have the affect that ATC sector boundaries are not always optimal for air traffic flows and ATM requirements. The non-optimal airspace structure then dictates the structure of the route network on which the traffic flows are accommodated. This former approach constrains the options for solutions, whereas the Top Down or Network-oriented approach (Appendix A.6 refers) is less constrained.

With this "Top Down" approach the main traffic flows are accommodated into a route network, which is independent of the existing sectorisation. Subsequent and suitable sectorisation must be developed to support the network, including the accommodation of all relevant traffic flows. A consequence of the above approach will be a re-organisation of sectors, involving at sector boundaries a delegation of ATS where necessary. At this initial proposal development stage the network requirements take precedence over sectorisation.

However, it must be recognised that because of the two-way relationship it may not be possible to develop an operationally viable and efficient sectorisation. As pointed out above, sector capacity is the crucial element in the whole ATM system. Route structure, although one of the main factors, is only one of the elements which determine sector capacity. Therefore, in those instances where the lack of adequate sector capacity may be a significant constraint on the ATM system, and whenever a proposed improvement in route alignment leads to a complication of the sector's organisation, resulting in an unacceptable reduction in capacity, then both the route alignment and sector configuration should be re-examined. Because of this two-way dependency between airspace sectorisation and route network, it is essential that both are addressed immediately after the initial proposal development stage and throughout the planning process this relationship is always taken into consideration.

Summary of method/rationale:

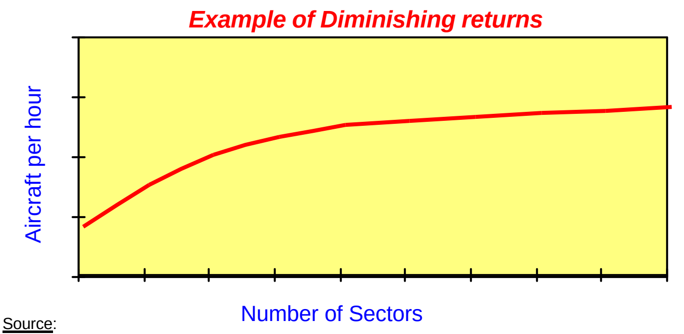
- Step 1: Route Network initial proposal
- Step 2: Examination of sectorisation viability
- Step 3: Harmonisation of outcome of step 1 and step 2

1.3 <u>Airspace Structure: Options to enhance ATM capacity at the sector level</u>

Air traffic control is currently based on sector structures. Sectorisation is the means of subdividing the totality of control tasks into manageable portions, at which throughput and capacity can be quantified. ECAC airspace has currently in excess of 400 sectors distributed in more than 50 ACCs. Capacity is a theoretical indicator of traffic loads, which can safely be handled by a sector team, rather than the loading they are currently subject to.

The main constraints on ATM capacity are airspace limitations and controller workload. The classic method to overcome these constraints is to provide more sectors. By either resizing or providing additional sectors, one can reduce the airspace volume, the number of routes/crossing points (conflictions) and the number of aircraft on the frequency at any time. This results in a reduction of workload and a corresponding increase in capacity, while maintaining at the same time a balanced co-ordination workload (e.g. through the use of improved/ automated co-ordination procedures).

The sub-division of sectors is a finite strategy and a point is reached, when the benefit of further reduction is outweighed by other factors (especially in the core area). Furthermore, the increase of capacity is not proportional to the number of sectors available (law of diminishing returns).



<u>Source</u>:
UK NATS R&D Report 9614
ASSESSMENT OF CAPACITY SHORTFALL IN THE ECAC AIRSPACE THROUGH 2000-2015
by Dr S Mandal & V Overend

Therefore, the efforts to handle traffic growth have to be focused on a more efficient method, which is to increase sector productivity and consequently capacity. This can be achieved by reducing the complexity of the airspace structure, resulting not only in a more balanced distribution of traffic within different sectors, but also in a redistribution of workload. The redistribution should be made on a sector to sector balanced basis.

<u>Note</u>:
Whichever method is used will entail a cost in either human and technical resources or non-optimum route/flight profiles

1.3.1 **Option 1 : Additional Sectors**

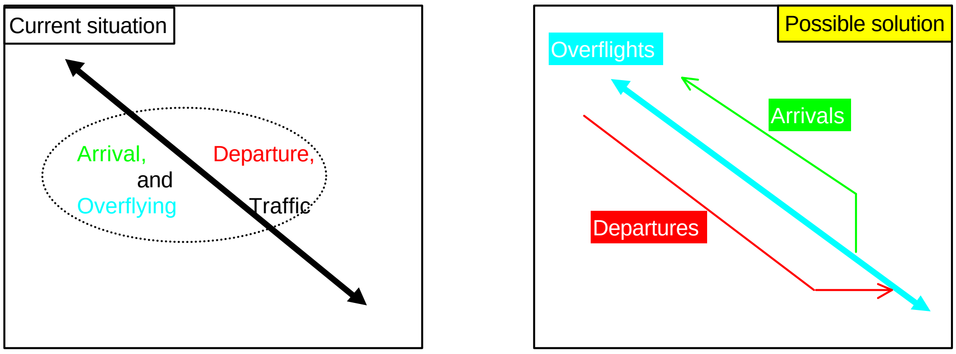
The provision of additional sectors is the classic method of increasing capacity. Although scope still exists for this in most of the ECAC airspace outside the core area or in the upper layers (vertical split), this is not always the most efficient method. Furthermore, in the core area the introduction of additional sectors is not always possible because:

- limits are almost reached (diminishing returns)
- frequency shortage
- co-ordination burden (workload increases)
- short transit times
- complex network (within Lower Airspace, especially close to TMAs)

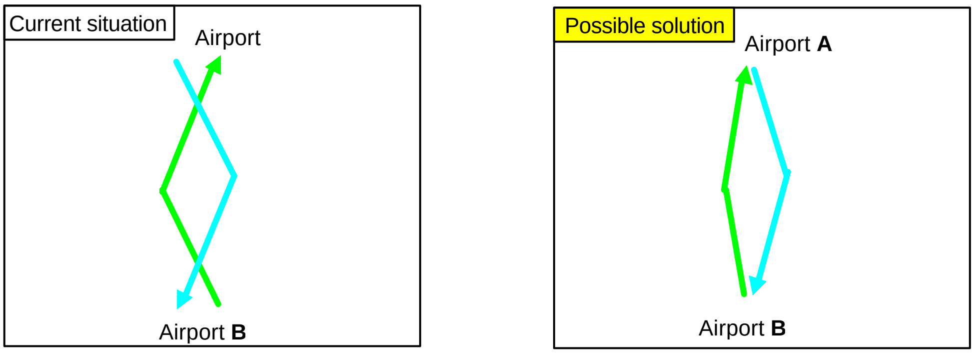
1.3.2 **Option 2 : Increased Sector Capacity**

In the core area especially, therefore, the efforts of the RNDSG must be focused on increasing sector capacity. This objective can be facilitated, if airspace planners in the overall design of the route network bear in mind the need to reduce the complexity of ATS route structure and thereby control tasks by:

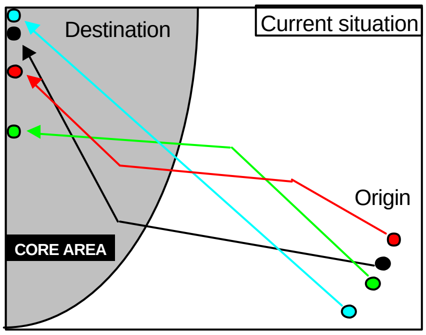
keeping the number of ATS routes controlled by a sector to a minimum
specialisation of routes (dualised routes/deconflicted ARR/DEP routes)

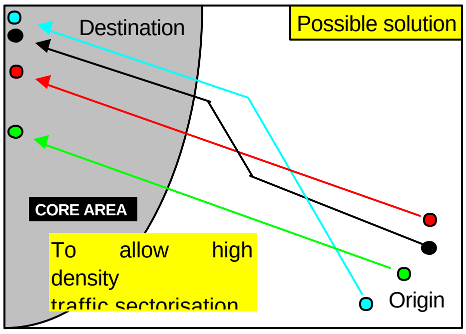


- deconfliction of traffic flows (elimination of unnecessary cross-overs)

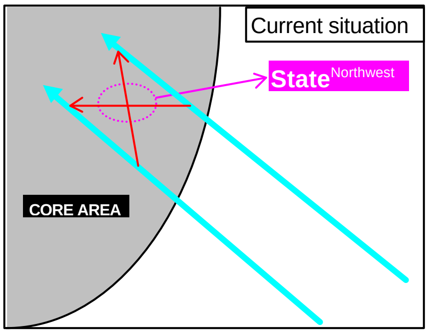


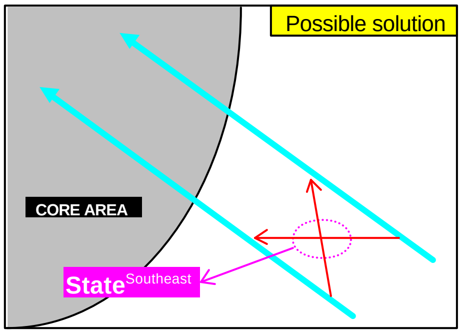
- organisation of traffic flows (segregation of main traffic flows)



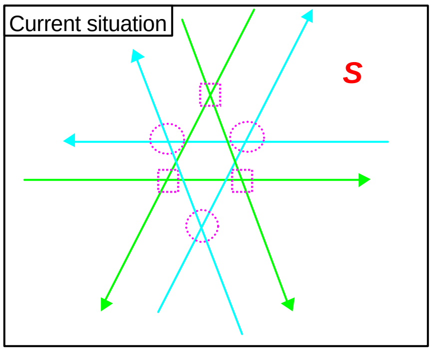


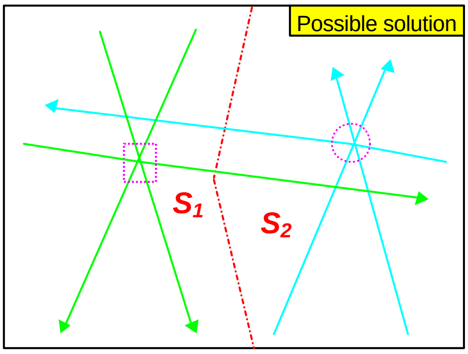
- appropriate relocation of crossing points, where possible





- rationalisation of crossing points, where possible





Consequently, from the planning phase onwards, it is necessary to take into account a certain number of **criteria** to ensure that a given sectorisation scheme is feasible in relation to a planned network.

1.4 Criteria

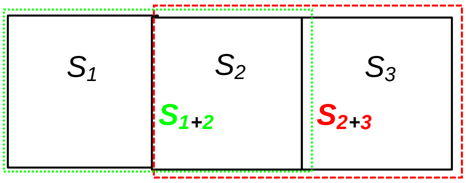
As a fundamental tool to ensure the relationship mentioned above, it is necessary to have standardised criteria developed by the RNDSG in order to establish, modify or validate en-route and Terminal sectors.

1.4.1 General Criteria Applicable to Sector Development :

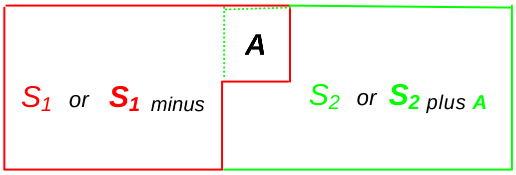
Sectorisation architecture should be:

- based on operational requirements
- planned on a coordinated, international basis
- drawn up independent of FIR or national boundaries
- operationally efficient, i.e. maximise ATM capacity while accommodating user demand

- fully consistent with the evolution of the route network
- fully consistent with the airspace utilisation (CDRs / route scenarios)
- sufficiently flexible to respond to varying traffic demand and to temporary changes in traffic flows (morning, evening, week, week-end traffic), this includes:
  1. *the combination of sectors to balance varying demands*



  2. *the reconfiguration of sector boundaries through use of air blocks to match prevailing traffic flows*



- constructed to ensure operational and procedural continuity across national borders
- designed to take into account military requirements and those of other airspace users
- configured to ensure optimum utilisation of the ATS route network (balanced load on the sectors)
- configured to minimise co-ordination workload
- designed, where appropriate, to utilise techniques based on specialisation of task depending on the nature of traffic and its density
- designed, in general, to be laterally larger for high level sectors than the underlying lower sectors in respect to traffic density and complexity

Requirement for additional vertical sectorisation may be necessary when RVSM (Reduced Vertical Separation Minima) is implemented

- based on the following factors:
  - traffic volume/density utilising up-to-date data and projected trends
  - traffic complexity
  - nature of traffic (en-route, climbing or descending traffic)
  - ATC system capability

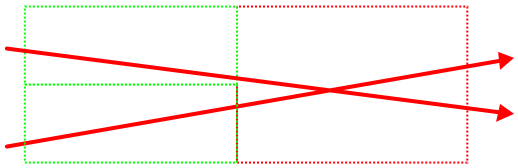
1.4.2 **Specific Criteria To Enhance Sector Capacity :**

I. Conflict Points:

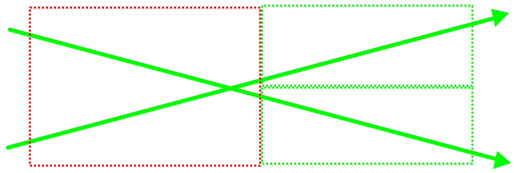
Sectorisation architecture should:

- limit number of conflict points in the same sector involving major traffic flows

- avoid different sectors feeding the same sector with converging traffic, when action to separate individual aircraft is required (two different co-ordinations for the receiving sector)

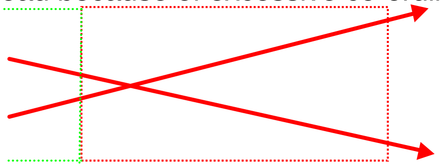


NO



YES

- avoid conflict points close to the boundary of a sector for entering traffic (increasing workload because of excessive co-ordination/no anticipation possible)



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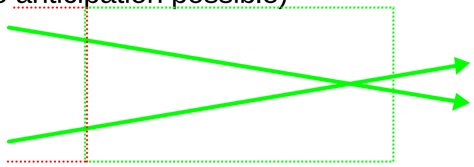


YES

II. Sector Functions/Specialisation

- in order to enhance sector capacity the functions (arrival, departure and en-route) carried out by one sector should be minimised
- ‘Flight Level Allocation’ procedures should be evaluated and the optimum system applied

  Note:
  Due to the upstream and downstream impact such procedures should be coordinated.

III. Sector Size (Big Sectors ¬ ¾ ® Small Sectors)

- The shape and size of a sector is a function of the tasks which can be efficiently carried out in the sector. The configuration and size of the sector therefore involves trade offs involving traffic volume, complexity and control task.
- regarding vertical and horizontal extension a sector should be:

  small enough to accommodate sector functions, while providing a balanced workload, and allow:

  * one specialised function
  * high rate of entering traffic
  * short transit time and low instantaneous loads

  and at the same time

  big enough to accommodate sector functions while not imposing an excessive workload and allow:

  * anticipation and resolution of conflicts with a minimum of co-ordination
  * the establishment of holding patterns without requiring co-ordination
  * RNAV offset procedures
  * radar vector separation techniques
  * tactical direct routeings
  * reasonable transit time (less co-ordination)

Low traffic density allows bigger sectors, whereas as density increases, a resizing into smaller ones becomes inevitable. The relative benefits from different sizes of sectors can be indicated as follows:

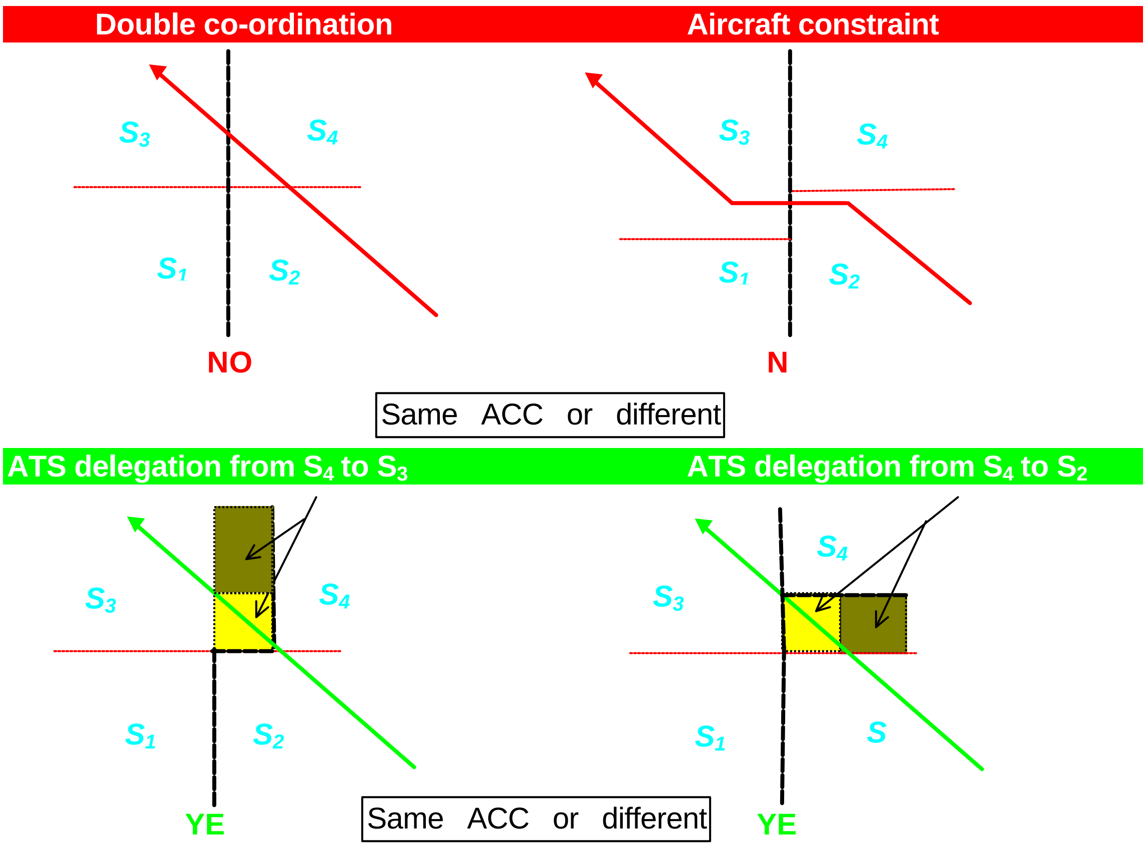
big sector ⟵ *versus* ⟶	**small sector**
better flexibility	better productivity
better anticipation	better efficiency through specialisation
more appropriate for varying flow demand	more rigid

The optimum size of sectors will therefore depend upon a case-by-case analysis.

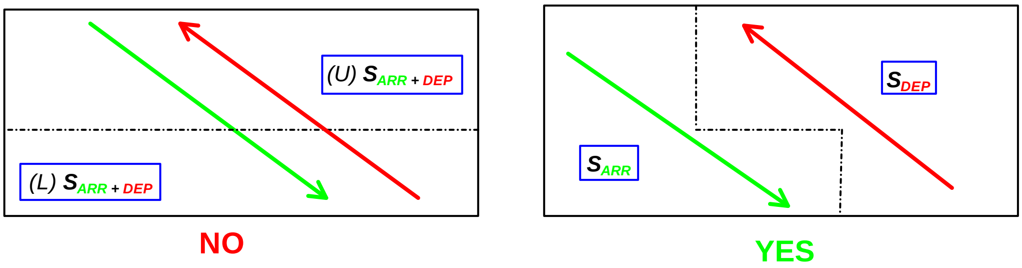
IV. Sector Boundaries/Sector Shape

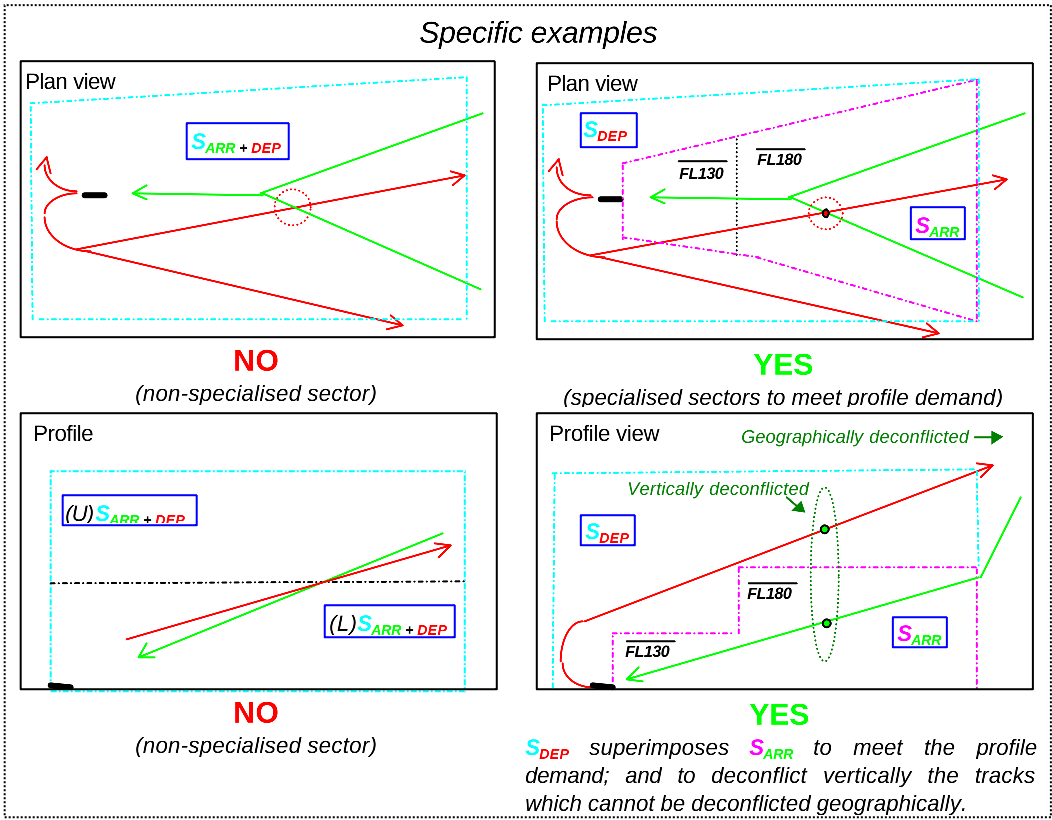
Sectorisation architecture should:

- be based on operational requirements rather than national boundaries
- promote overall system flexibility (grouping/de-grouping of sectors/collapsed sectors because of FUA/CDRs or during low traffic periods)
- reduce co-ordination/workload and facilitate radar hand-over
- avoid too short a transit time within one sector, e.g. by delegating a part of the airspace (ATS delegation)



- shaped along main traffic flows
- take into account the ideal profile and performance of aircraft



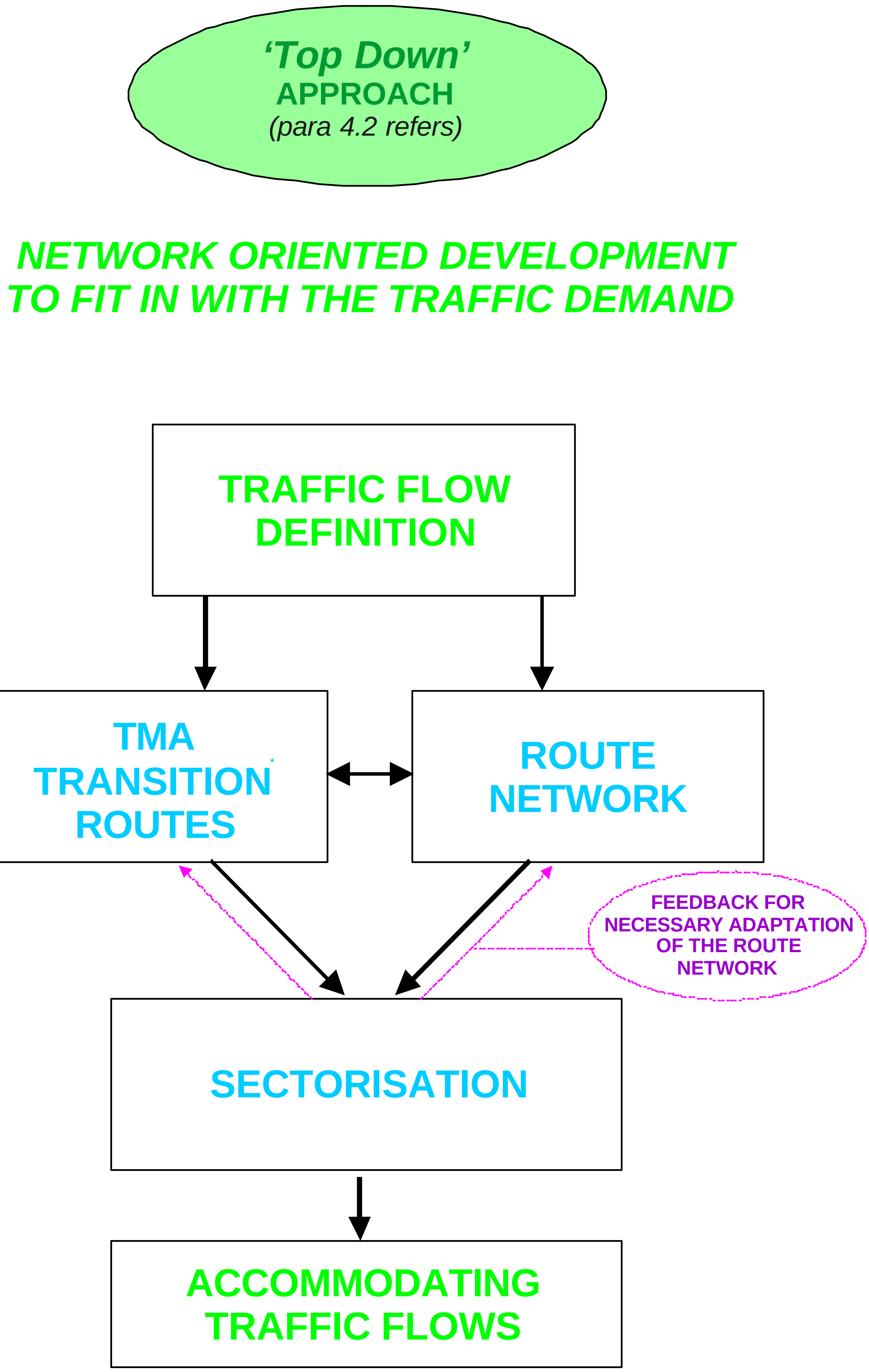


- promote overall system flexibility in support of fuel-efficient direct routes
- have varying division levels/level splits all over Europe depending on traffic patterns/source of traffic and the performance of aircraft (this means that a "standard" division FL 245 between Upper and Lower Airspace could be a constraint)
- arrange sector splits horizontally, if overflying traffic is dominant (sector slices)
- arrange sector splits vertically, if climbing and/or descending traffic is dominant (sector columns)

1.5 Application of Criteria

In regard to the all of the foregoing criteria it should be noted that local requirements will dictate their appropriateness or otherwise. Airspace planners must also ensure that the application of any of the criteria or the solution of a local problem should not adversely affect adjacent airspace, or the overall capacity of the ECAC airspace.

Annex 4C


'Top Down'
APPROACH
(para 4.2 refers)
NETWORK ORIENTED DEVELOPMENT
TO FIT IN WITH THE TRAFFIC DEMAND
TRAFFIC FLOW DEFINITION
TMA TRANSITION ROUTES
ROUTE NETWORK
FEEDBACK FOR NECESSARY ADAPTATION OF THE ROUTE NETWORK
SECTORISATION
ACCOMMODATING TRAFFIC FLOWS

SECTION 4

GUIDELINES FOR ATS ROUTE NETWORK DEVELOPMENT AND SECTORISATION

FINAL PAGE

SUGGESTION - COMMENTS

To report any errors, or to propose a modification to the present Section 4 "Guidelines for ATS Route Network Development and Sectorisation", please contact:

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EUROCONTROL
Airspace Management & Navigation Unit (AMN)
Rue de la Fusée, 96
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SECTION 4 - SPONSOR: ROUTE NETWORK DEVELOPMENT SUB-GROUP

Whenever material received, in accordance with the above procedure, makes it apparent that an amendment of the present Section 4 is required, such amendment will be first discussed within the Route Network Development Sub-Group (RNDSG) before its adoption by the Airspace & Navigation Team (ANT).

PUBLICATION OF AMENDMENT

The agreed amendment will then be issued by EUROCONTROL in the form most convenient for its insertion in the Planning Manual.

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SECTION 5

GUIDELINES FOR TERMINAL AIRSPACE DESIGN

5.1 FOREWORD

5.1.1 The aim of the Terminal Airspace Design Criteria is to provide generic operational guidelines for those involved in terminal airspace design.

5.1.2 Many national administrations are devolving responsibility for terminal airspace design to those units responsible for providing service within that airspace. In many cases, the responsibility falls upon operational personnel who have not previously carried out the task. Whilst this section is aimed primarily at assisting such individuals, it can also be used as a first reference by States who are considering changing their terminal airspace structures.

5.1.3 The methodology described in this section is aimed at assisting the process of assessing and evaluating the terminal airspace structure by following a methodological approach which includes the identification of constraints. An outline of the principles involved in terminal airspace design are also provided.

5.1.4 The guidelines have been written in a generic manner in recognition of the fact that each terminal airspace is unique. Furthermore, because there are many parameters which affect the design of terminal airspace (such as a need to respond to changing circumstances or certain policies adopted by States) a multiplicity of design criteria is inevitable. This said, there are many areas of commonality which can be identified and which form the basis of this section.

5.1.5 Similarly, the guidelines are operational in aspect; they do not seek to replicate existing Procedures design criteria already well document in ICAO Doc. 8168 Vols. I & II or EUROCONTROL publications.

5.1.6 Whilst the current version of this section does not explore the navigation aspect of terminal airspace, the revised version will take into account the implementation or development of navigation technology such as Area Navigation.

5.1.7 It is therefore intended to review completely these guidelines within the next two years in the light of recent developments and experience gained.

5.2 BACKGROUND

5.2.1 Introduction

There is a requirement to establish an area of airspace in the vicinity of certain airports to provide a degree of protection for aircraft operations in order to provide a safe system of Air Traffic Control. Generally this airspace is established in the vicinity of airports at which Air Traffic Control Services (ATS) are provided to aircraft operating under Instrument Flight Rules (IFR).

Due to the dynamic development of aviation a complex system of terminology has evolved. A number of terms are used to describe the airspace in the vicinity of aerodromes, all of which are, essentially, providing a similar function. Some of these terms are defined within ICAO others are not.
For the purposes of this document the following definition is used:

"**TERMINAL AIRSPACE** is a generic term describing airspace surrounding an airport within which air traffic services are provided. It encompasses all the various terminologies currently used throughout the ECAC region".

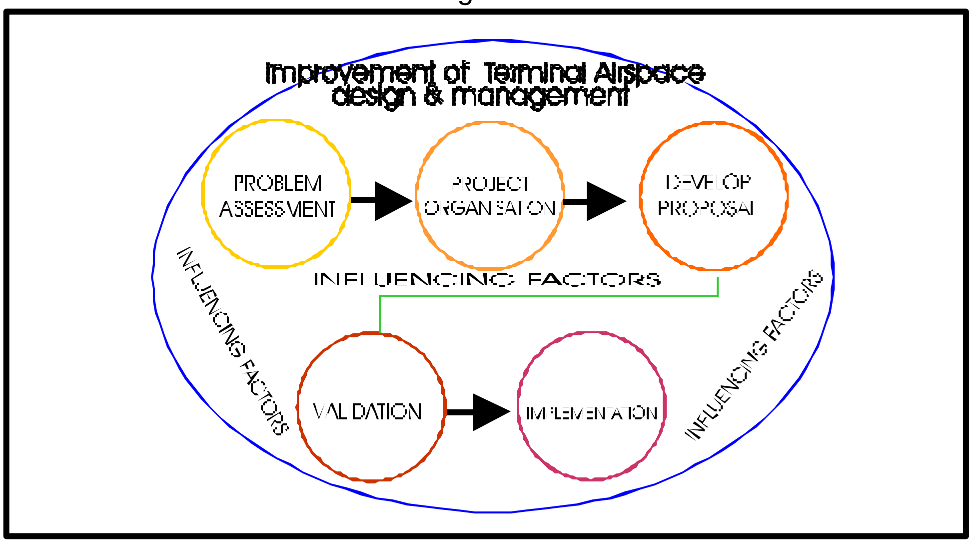
[Explanatory note: *The above is aimed at including TMA, CTA, CTR, SRZ, ATZ airspace classification or any other nomenclature used to describe the airspace around an airport*].

N.B. ICAO does not currently use or define the term ' Terminal Airspace '.

The design of such areas of airspace is subject to many considerations which will inevitably vary from location to location dependent upon local requirements. Therefore to lay down a comprehensive outline of airspace design principles relevant to all locations is unwise. However, a broad methodology for airspace design is a factor common to the majority, if not all, areas of terminal airspace.

This methodology may be illustrated as follows:

Diagram 1-1



5.2.2 ICAO Basis for terminal airspace design

ICAO documentation provides extensive information for the design of terminal airspace. This provides for progressive development of the airspace concerned. The information is contained in a variety of documents which include:

Annex 2	Convention on Civil Aviation - Rules of the Air.
Annex 11	Convention on Civil Aviation - Air Traffic Services.
Doc. 4444-RAC	Rules of the Air and Air Traffic Services.
Doc. 9426-AN	Air Traffic Services Planning Manual.
Doc. 8168-OPS	Aircraft Operations - Volume II.
Doc. 9368-AN	Instrument Flight Procedures Constructions Manual.
Doc. 9371-AN	Template Manual for Holding, Reversal and Racetrack Procedures.

The information relates to four main subjects :

a. Procedure design aspects.

b. The configuration of terminal airspace structures.

c. The division of responsibility for the provision of ATS.

d. The determination of ATS airspace classifications.

These subjects provide the basis for terminal airspace design at all levels of traffic density. Many other subjects are also covered in the ICAO documentation e.g. standard departure and arrival routes and associated procedures, the use of radar, mixed IFR/VFR operations, construction of visual and instrument flight procedures, etc. These subjects complement and expand upon the basic provisions and are utilised at locations requiring these types of operations.

5.2.2.1 Procedure Design Aspects

ICAO provides extensive information regarding the design of terminal airspace procedures.
Information relating to their construction is provided for guidance of procedure design specialists and describes the essential areas and obstacle clearance requirements for the achievement of safe, regular instrument flight operations.

Procedure design information relates to three main aspects of terminal airspace operations:

a. Departure procedures - these are established for each runway where instrument departures are expected to be used.
b. Arrival procedures - which may have five separate segments: arrival, initial, intermediate, final and missed approach.
c. Holding procedures - in which a holding area is established based upon a number of variable factors.

Clearly, the design of terminal airspace structures will be closely linked to the associated departure, arrival and holding procedures established for the aerodrome(s) in question. Therefore it is necessary for an airspace planner to have a knowledge of the existing, or proposed, procedures for the location that the airspace structure will serve.

5.2.2.2 <u>The Configuration of Terminal Airspace Structures</u>

ICAO requires that, once it has been decided that ATS are to be provided, the airspace, wherein such services are rendered, should be designated by the following terms :

a. *Flight Information Region (FIR)* - That portion of the airspace where it is determined that flight information service and alerting service will be provided shall be designated as a flight information region.

b. *Control Area (CTA)* - A controlled airspace extending upwards from a specified limit above the earth. The lower limit of a control area shall be established at a height above the ground or water of not less than 200 m (700 ft).

   Control Areas may be formed by:

   i. terminal control areas (TMAs)
   ii. interconnecting airways
   iii. area-type control areas

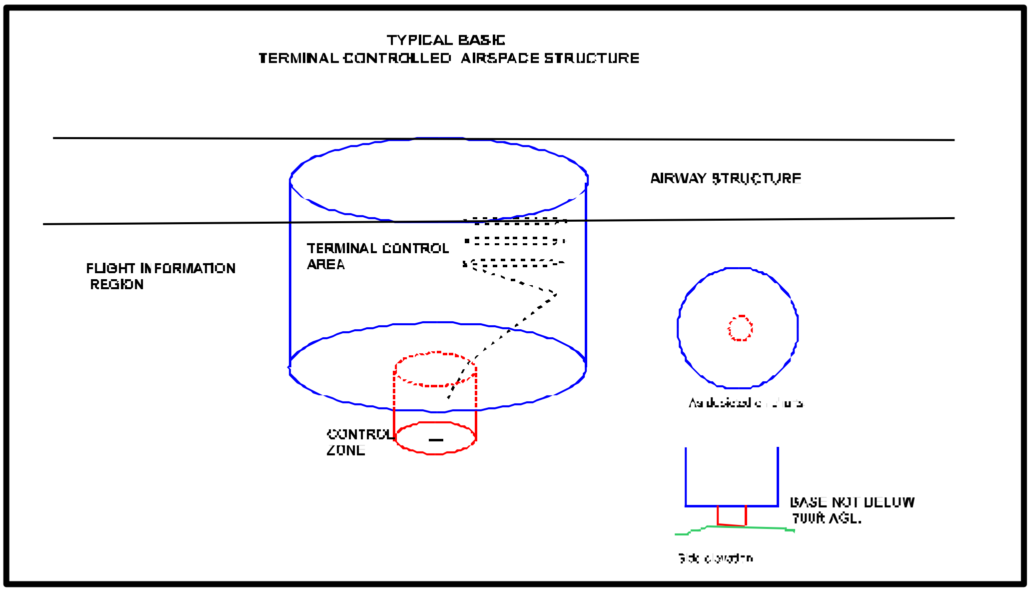
c. *Control Zone (CTR)* - A controlled airspace extending upwards from the surface of the earth to a specified upper limit. The lateral limits of a control zone shall extend to at least 9.3 km (5 nm) from the centre of the aerodrome or aerodromes concerned, in the directions from which approaches may be made.

N.B. A control zone may include two or more aerodromes situated close together.

Those portions of the airspace where it is determined that air traffic control service will be provided to IFR flights shall be designated as control areas or control zones.

These basic structures are used by States in a variety of different ways with the intention of providing sufficient controlled airspace to encompass (where necessary) the flight path of IFR traffic arriving and departing from an aerodrome. In this context aircraft holding in the vicinity of aerodromes are considered as arriving aircraft. A basic configuration is shown in Diagram 1-2.

Diagram 1-2



In this diagram the terminal airspace and control zone are depicted as being circular. The actual shape selected for a particular location will be determined by the specific site requirement.

5.2.2.3 Terminal Airspace Classifications

ICAO requires that ATS airspace be classified and designated according to the ICAO published ATS Airspace Classification list. The annotation of a portion of airspace as being a particular airspace classification serves a similar purpose as annotating that airspace as an airspace structure, for example, a control zone or control area.

Airspace classification selection may significantly impact upon the capacity of terminal airspace. This is associated with the consideration for:

'measures required to ensure that a possible mix of instrument flight rules (IFR) and visual flight rules (VFR) operations at and around the aerodrome(s) in question do not impair the safety of flight operations.' *- Doc. 9426*

Annex 11 makes provision for controlled airspace which allows VFR operations without any restrictions together with that which includes VFR restrictions. This leads to the concept of three types of controlled airspace:

- **instrument restricted airspace** ***classification A***
  allows for IFR operations only.

- **instrument / visual** ***classifications B, C, D***
  allows for both IFR and VFR operations in a controlled environment.

- **visual exempted** ***classification E***
  allows for both IFR and VFR operations but VFR operations are not controlled.

In addition, provision is made for uncontrolled airspace :

- **air traffic advisory / flight information service** ***classification F***
  allows for both IFR and VFR operations in which all participating IFR flights receive an air traffic advisory service.

- **flight information service** ***classification G***
  allows for both IFR and VFR operations in which aircraft receive a flight information service if requested.

It is a matter of policy for the particular terminal airspace authority concerned to assess the level of control required for VFR operations and to provide a solution to the problem of mixed IFR/VFR flights in the same airspace. Total prohibition, as in classification A airspace, deprives certain users of airspace and associated facilities. However, if there is a likelihood of collision risks, a degree of restriction upon VFR operations may be necessary, for example, a requirement for aircraft to carry specific equipment, restriction of flight to certain areas and/or routes.

This restriction of VFR operations may be applied by the use of airspace classification. When VFR operations need a lower degree of containment, then the airspace classification can be correspondingly less restrictive.

In applying this concept, Class B airspace shall therefore be considered less restrictive than Class A airspace, Class C airspace less restrictive than Class B airspace etc.

In general, a more restrictive class of airspace is introduced as traffic density increases. However the actual classification associated with a particular density of traffic will vary from location to location depending upon circumstance and preference. For example, the classifications in the vicinity of the busiest airports in Europe vary from Class A airspace to Class E airspace. In addition, a general trend, mainly to accommodate General Aviation, is to use less restrictive class airspace at lower altitudes than is used at higher altitudes.

An example of this is of a control zone being annotated Class D so that VFR flights may access the associated airport (while providing protection for IFR flights) whilst the control area established above the control zone is annotated Class B airspace. VFR operations are thus restricted to a greater degree but are still able to operate *beneath* such a control area.

5.2.2.4 Terminal Airspace Division of Responsibility

ICAO provides guidance on the division of responsibility for the provision of air traffic services, *inter alia*:

'*The division of responsibilities between TWR and APP and between APP and ACC cannot be rigidly defined because the responsibilities depend very much on local conditions which vary from location to location. They must therefore be determined in each case and with due regard to traffic conditions, its composition, the airspace arrangements, prevailing meteorological conditions and relative workload factors. However, arrangements governing the division of responsibilities between these different parts of the ATS service, should not result in increased requirements for co-ordination and/or an undesirable inflexibility in the use of airspace, nor in an increased workload for pilots because of unnecessary transfers of control and associated radio communication contacts.' - Doc. 9426*

The division of responsibility for the provision of ATS between ACC and APP is increasingly becoming a major influencing factor of terminal airspace capacity and efficiency. This is especially so in areas of high traffic density in which the potential requirement for co-ordination is extensive thus imposing greater workload upon controllers and pilots.

ICAO indicates that the division between the provision of an area control service and the provision of an approach control service is not clearly defined. At some locations, approach control units carry out area control functions whilst, at others, area control units perform approach control functions.

'*The parts of air traffic services .... shall be provided by the various units as follows:*

a. ***Area control service***

i. by an area control centre

or

ii. by the unit providing approach control service in a control zone or in a control area of limited extent which is designated primarily for the provision of approach control service and where no area control centre is established.

b. ***Approach control service***

i. *by an aerodrome control tower or area control centre when it is necessary or desirable to combine under the responsibility of one unit the functions of the approach control service with those of the aerodrome control service or the area control service*

or

ii. *by an approach control office when it is necessary or desirable to establish a separate unit.*

- Doc. 4444

It can be seen, therefore, that many approach control responsibilities may be divided between different air traffic units.

5.2.3 The tasks associated with approach control

5.2.3.1 The Overall Responsibility

The Approach Control task is primarily concerned with the control of IFR flights arriving at and departing from aerodromes. Prescribed separation standards are applied between aircraft. These separation standards are determined for an individual location dependent upon equipment standards and operational practices. In order to fulfil this task, and in order to apply the appropriate separation, consideration must also be given to VFR flights and transit aircraft operating in the same airspace. A number of factors will influence the method by which this task is performed. Main factors will include the design of the airspace and the associated functional division of the airspace. To provide an analysis of terminal airspace design it is necessary to understand the operations occurring within the airspace. For this purpose the Approach Control task may be divided into three *sub-tasks,* as shown below.

5.2.3.2 The Approach Control Tasks

a. The arrival task

In the arrival task, aircraft are sequenced into an orderly traffic flow in an area of convergence with a diminishing volume of airspace.

A major feature of arriving traffic in terminal airspace is the lack of adherence to the published route structure. Many airports publish Standard Arrival Routes (STARs) which are intended to permit transition from the en-route element to the approach phase of flight. In addition, Instrument Approach Procedures are published for individual runways. However, these procedures are rarely fully utilised. Preference is given instead to positive ATC handling, using altitude, speed variation and heading instructions with the aid of radar (i.e. vectoring). When vectoring is employed within terminal airspace, aircraft are neither expected to nor allowed to follow published routes or to deviate from headings issued until specifically cleared to commence an instrument or visual approach to the airport. Therefore, (except at those locations operating a procedural approach system without radar) STARs, although used by pilots for flight planning purposes, do not necessarily provide an indication of terminal area routeing. Actual routeings are influenced by a number of factors, including traffic density, weather conditions, aircraft characteristics, controller technique, etc.

Radar vectoring allows the flexibility to adjust traffic flows in order to optimise separation between arriving aircraft to a greater degree than is possible with other conventional navigation/management tools. The degree of vectoring is dependent upon the availability of airspace for use by the controller exercising the Approach arrival function, and this will be determined by the design and functional division of the airspace.

b. The departure task

The departure task entails aircraft moving from a defined point, i.e. the runway, to an area of airspace with greater volume i.e. the en-route structure. Separation between departing aircraft may, in many cases, occur geographically soon after departure by application of diverging departure tracks. Separation may also be achieved by application of appropriate time intervals between aircraft on the same route. Two identifiable systems are employed for addressing the tasks associated with the departure phase:

i. the introduction of Standard Instrument Departure routes (SIDs).

ii. a flexible system in which individual departure clearances are given.

ICAO recommends that SIDs should be established to permit aircraft to navigate along the routes without radar vectoring. This reduces the workload of the controller responsible for departing traffic. This workload reduction may allow for an increase in capacity within the ATC system. However, at some locations, the intervention of radar may assist in increasing departure capacity by vectoring aircraft to the connection point with the en-route environment, thus providing an alternative strategy to a rigid SID structure.

c. Interacting traffic flows

This task entails the provision of separation between arrival and departure traffic flows. At many locations it will also entail separation between these traffic flows and overflying aircraft.

This separation may be established by two basic methods:

i. the introduction of a SID and STAR structure which will establish a strategic deconfliction of traffic flows.

ii. a flexible system in which each aircraft is provided with the required separation on an individual basis.

The strategic deconfliction of arrival and departure routes may provide for a reduction of ATC workload and, therefore, the potential for an increase in capacity. This deconfliction of arrival and departure routes may be achieved on a geographic (lateral) basis or by vertical means (level separation). The method utilised will be determined by the traffic flows associated with a particular location and the design principles adopted.

5.2.3.3 The Division of Tasks

The three *sub-tasks* associated with Approach Control may be exercised by one individual controller or, particularly at busy locations, may be divided between two or more controllers. A number of methods may be used for this division of responsibility. The method chosen will be determined by the airspace design and functionality principles adopted for the particular location. The division may result in a controller being given responsibility for a specific area which is geographically or vertically divided from adjacent areas. Alternatively. a controller may be given responsibility for a particular traffic flow e.g. arriving or departing traffic.

These divided *sectors* may be opened or combined, depending upon the traffic density at any given time. This provides for flexibility in operations and optimisation of ATC resources.

5.3 THE FUNCTION OF TERMINAL AIRSPACE

5.3.1 Progressive development of terminal airspace

Due to the evolutionary nature of terminal airspace design at the majority of locations, it is becoming increasingly necessary to monitor developments in order to ensure that the airspace structure provided meets, *as far as practical,* the requirements demanded from it. Many existing terminal airspace structures have been in place, without significant alteration, for a period of thirty years or more and in many cases reflect the requirements of previous generations of aircraft.

The actual terminology and formal structures associated with terminal airspace are reducing in importance. The primary concern now is with the *functions associated with the airspace in question*.

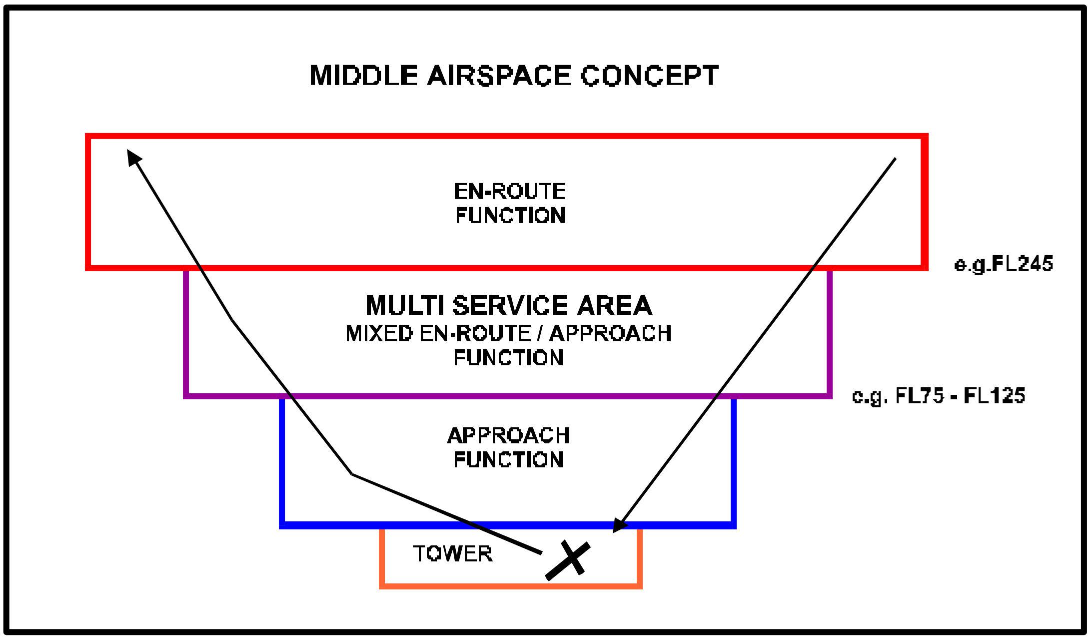
ICAO Doc. 9426, the Air Traffic Services Planning Manual, states:

The division of responsibilities between APP and ACC requires particularly careful consideration because it can have a significant effect on the capacity of the ATC system at the location concerned, especially as regards the requirement for co-ordination and the workload imposed on both controllers and pilots. It has, for instance, been found that at some busy major aerodromes, the arrangement whereby departing traffic is transferred directly from the aerodrome control tower to a departure control position in the associated ACC, or only that part of arriving traffic which has been brought into a position where it no longer constitutes traffic to other departing or overflying traffic is released to APP by the associated ACC, has contributed to an optimum flow of considerable amounts of air traffic while keeping the workload within manageable proportions. It should, however, be noted that such arrangements depend specifically on the local situation and that they should only be applied after careful consideration of all the relevant factors by all parties concerned.

In numerous cases it has been found that arrangements between APP and ACC, which leave the transfer of control of departing as well as arriving traffic between them to ***ad hoc*** *agreements made in the light of the overall traffic situation, have worked well whenever the will on both sides to obtain results has prevailed over the thinking in pure categories of competence.*

The division of responsibility for the provision of ATS is seen as a major influencing factor on terminal airspace capacity. However, it may not be possible to identify clearly the division between en-route and terminal airspace. That airspace associated with the upper en-route function may be distinguishable, as may be the lower levels of airspace in which no significant en-route functions occur and where the approach service is the predominant function. However, there is airspace situated between these areas of airspace in which both the en-route and approach elements are provided. This *middle* airspace may also be called *multi-service* airspace. This is illustrated in Diagram 2-1. However, note that the Flight Levels given are examples only and are not prescriptive.

Diagram 2-1



This *middle* or *multi-service* airspace does not require a formal new airspace designation but can be catered for by:

a. increasing the upper limit of the area of responsibility of an Approach Control unit.

and/or

b. lowering the base of the area of responsibility of an Area Control unit.

The *multi-service* tasks associated with the Approach Control function which are carried out in this airspace include:

- transition from the departure phase to the en-route phase
- initial descent management to a holding facility
- radar vectoring for the approach sequence
- lower level en-route services interacting with arriving/departing traffic.

5.3.2 The functional division of terminal airspace

ICAO requires that an Approach Control Service shall be provided by an area control centre or by an approach control office when it is necessary or desirable to establish a separate unit.

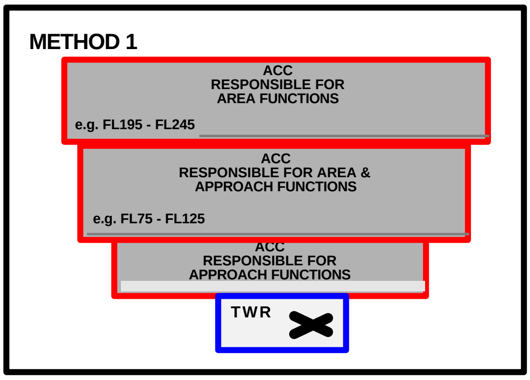
This results in a number of methods being utilised for the division of Approach Control functionality.

Three basic methods of design (in terms of ATC function) may be identified, as follows:

Method 1

This type of configuration may be associated with locations at which no Approach facility is established. All functions associated with approach control are carried out by the ACC, as shown in Diagram 2-2. A lower ACC sector may be established with responsibility for the approach function together with its en-route responsibilities. Alternatively, this may be incorporated into one en-route sector dependent upon the existing sectorisation and traffic density.

Diagram 2-2



Method 1 is based upon the scenario in which there is no APP unit established for the aerodrome concerned. The aerodrome is operated as an ADC facility only. The APP functions are carried out completely by the associated ACC.

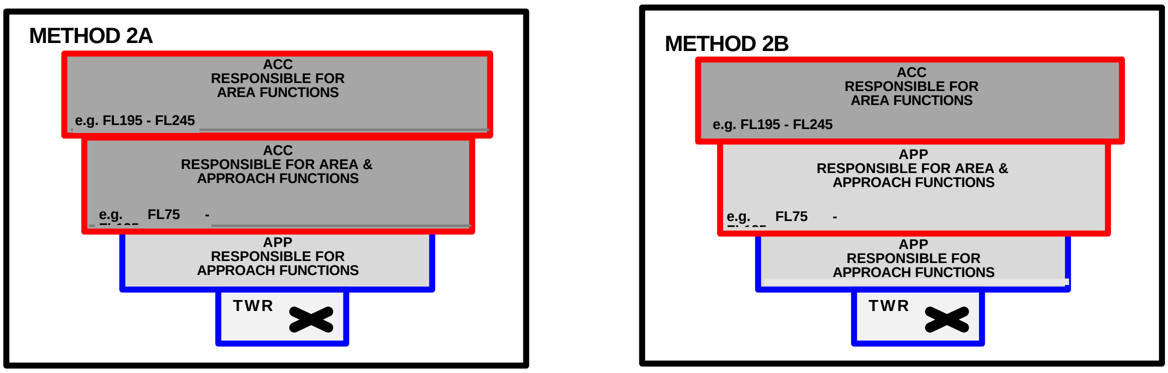
This method may be more increasingly utilised with the development of combined ACC/APP units in order to reduce co-ordination requirements. In this situation the APP unit is absorbed into the ACC facility and a 'stand-alone' Aerodrome Control (ADC) developed at the aerodrome concerned.

Co-ordination procedures associated with Method 1

There is clearly a reduction in overall co-ordination requirements consequent upon the absence of a dedicated APP unit, whilst co-ordination methods used in the ACC will be dependent upon the ACC sectorisation.

Method 2
This method involves the division of responsibility by flight level. Dependent upon local circumstances, it may be found that the type of configuration shown here is able to handle substantial numbers of operations in an efficient manner. This method may be further divided into method 2A or 2B, dependent upon whether ACC or APP takes the *middle airspace* function responsibility. These options are depicted in Diagram 2-3.

Diagram 2-3



Method 2A is based upon the 'traditional' divide between ACC and APP in which aircraft performance requirements dictate that some APP functions must be carried out by the ACC within what now may be termed the ***middle*** *airspace. Method 2B indicates the APP unit extended area of responsibility to include ACC functions in the airspace up to, for example, FL195 or FL245. The ACC does not carry out any APP functions as such.*

Co-ordination procedures associated with Method 2
The functional division associated with Method 2 may be operated by the use of ***dynamic co-ordination*** *(in which each aircraft is subject to individual co-ordination)* or by the use of ***standard co-ordination*** *(in which standard procedures for transfer of control are agreed)*.

Departing aircraft

Transfer from **APP** to **ACC**

Standard Agreement
At a predetermined point/level

Dynamic co-ordination
Separated from other APP traffic

Initial climb
APP
Intermediate climb
ACC (Method 2A)
APP (Method 2B)

→

En-route connection

ACC (Method 2A)
APP (Method 2B)

Arriving aircraft

Transfer from **ACC** to **APP**

Significant point (e.g. minimum stack level or airspace boundary)

Initial approach

ACC (Method 2A)
APP (Method 2B)

→

Intermediate approach

APP

→

Final vectoring

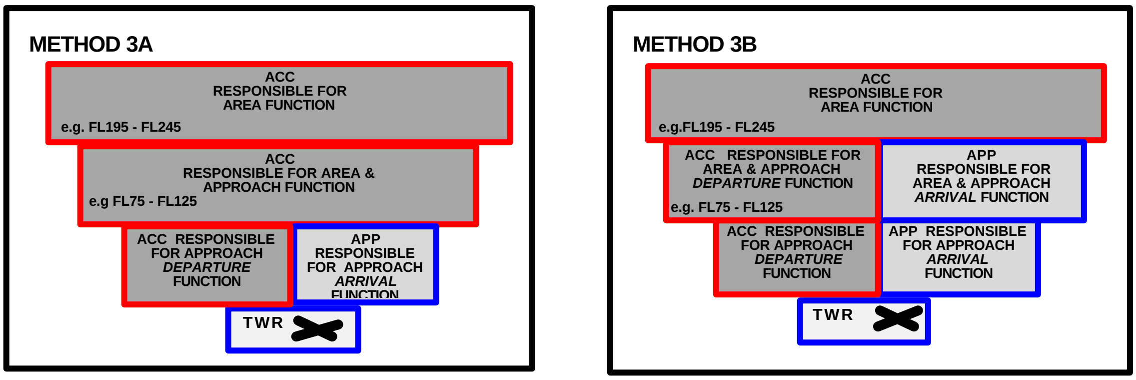
APP

Note: SIDs/STARs may not be established. However, if they are, then they may not necessarily be strategically deconflicted.

Method 3

An alternative method for handling high density traffic is the division of arrival and departure functions on a geographic basis. This configuration enables co-ordination to be kept to a minimum with regard to departing aircraft and may enable these departing aircraft to utilise a near optimum climb performance. The use of this method will be determined by the local conditions and operational practices in the airspace concerned. Method 3 is also subdivided into 3A and 3B dependent upon the division of responsibility, as shown in Diagram 2-4.

Diagram 2-4



*Method 3A indicates the extension of the ACC area of responsibility for the provision of the APP function to the departure phase together with the responsibility for **middle** airspace APP functions. The APP area of responsibility is confined to the arrival function being provided in the lower levels.*
*Method 3B indicates that, while the ACC area of responsibility for departures extends to the lower and **middle** airspace APP functions the APP responsibility is extended to the **middle** airspace for the arrival function.*

Co-ordination procedures associated with Method 3

The functional division associated with method 3 may be operated by the use of ***dynamic co-ordination*** *(in which each aircraft is subject to individual co-ordination)* or by the use of ***standard co-ordination*** *(in which standard procedures for transfer of control are agreed)*. However, due to the complexity of co-ordination associated with Method 3B, a standard co-ordination agreement may be the preferred option.

Departing aircraft

Transfer from **TWR**
DIRECT
TO
ACC

Initial / intermediate climb
ACC

→

En-route connection
ACC

Arriving aircraft

Transfer from **ACC** to **APP**

Method 3A
Designated level/position
(e.g. entry into final manoeuvring area or minimum stack)
Method 3B
Significant point
(e.g.airspace boundary or en-route connection)

Initial / intermediate approach
ACC (Method 3A)
APP (Method 3B)

→

Final vectoring
APP

Note: SIDs/STARs are generally established and de-conflicted.

5.3.3 Sectorisation of approach control and terminal areas

The functional division appropriate for a particular location will also influence the method of *sectorisation* within that airspace. There may also be more than one airport established at a particular location, and this may dictate the sectorisation requirements. This sectorisation may be a division of responsibility within the approach control unit *itself* or between APP and ACC. The division of responsibility between sectors should be assessed to provide for an optimised total ATC capacity. Flexibility is another consideration when determining sector configuration as the demand upon a sector may not be consistent throughout a given period. The potential for 'collapsing' sectors during periods of reduced traffic demand by combining two or more sectors together in order to optimise resources should also be considered.

The need for the sectorisation of the APP function and actual division of responsibility is site-specific. However, it is likely to be a function of traffic density and associated controller workload. At low density locations it may be possible to operate the APP function as one sector. As density increases, the need for sectorisation may occur. Options for the introduction of sectorisation include the establishment of a final approach director or the division of responsibility between arrival and departure functions. Within terminal airspace a geographic division between arrival and departure sectors or with sectors being divided either side of the runway in use is more common than a vertical division (due to aircraft performance characteristics). Another common consideration is the complexity of operations which is introduced when airports are situated in close proximity to one another. In some cases, there may be advantages to be gained by combining the approach functions of the individual airports, but this is again site-specific and may not always be possible.

5.3.3.1 Sectorisation Considerations

Some of the issues relevant to sectorisation are shown below:

- ATS route structure, entry and exit points, intersections, holding patterns
- aerodromes and runway configurations to be served by the sectors
- flight profiles
- navigation tolerances on ATS routes and holding areas
- airspace required for ATC-initiated flight paths (i.e. vectoring areas)
- routeing and flight levels for transit air traffic
- control methods applied to air traffic within the sector
- factors influencing the division of responsibilities and co-ordination between APP and other units
- physical considerations (operational positions, communications and/or radar coverage, etc.)
- other airspace user requirements (e.g. military operations).

Note: The number of aircraft handled at a given time by a controller in approach control is normally significantly less than a controller in area control. This is due to the generally more complex nature of aircraft operations in the terminal airspace environment.

5.3.3.2 Sectorisation Options

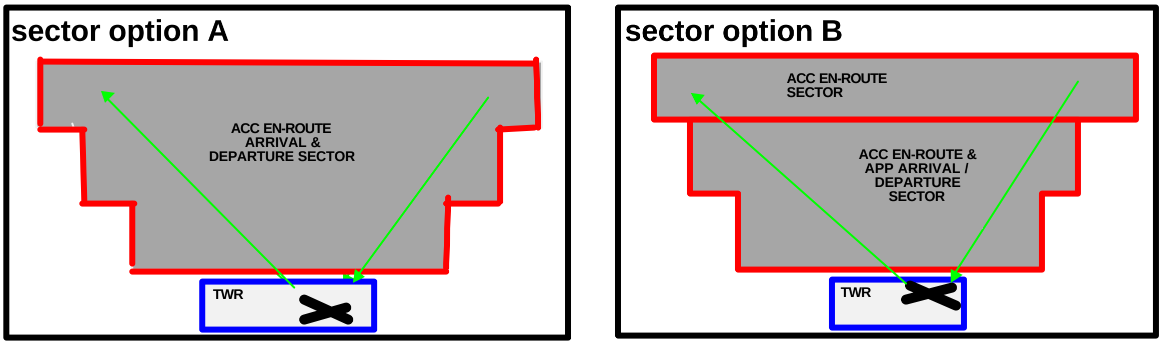
Sectorisation may occur between ACC and APP operations. In this situation, sectorisation may be established in a similar way to that employed for division of functionality, with responsibility being divided between ACC and APP. Of course, in Method 1 all sectorisation occurs in the ACC operation.

Sectorisation may also be operated with separate Approach sectors. Although these may be used with either Method 2A or 3A, they are more commonly associated with Methods 2B or 3B in which APP has an extended area of operational responsibility.

Some sectorisation options associated with the particular functionality division are given below in Diagrams 2-5, 2-6 and 2-7. These options are not exhaustive and it must be re-emphasised that sectorisation will be site-specific.

Diagram 2-5

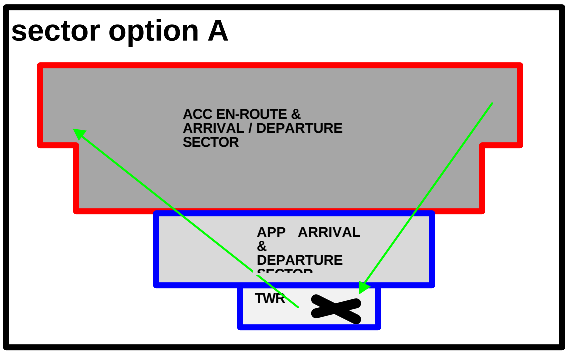
METHOD 1

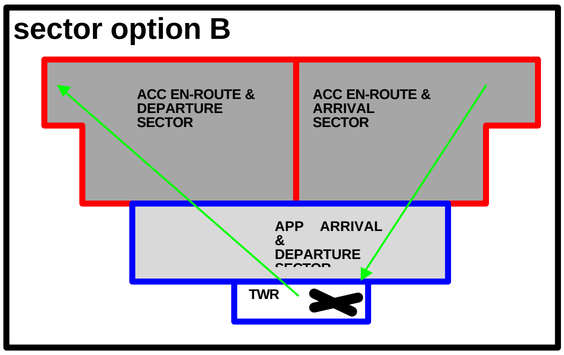


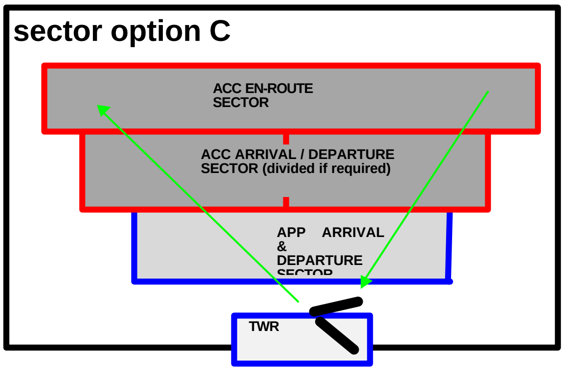
All sectorisation is associated with the ACC. No separate APP unit is established. The airport location itself has only an ADC function. In general, arrival/departure traffic density is sufficiently low to allow arrival and departure functions to be carried out by the en-route sector. However, if higher traffic density occurs it may be necessary to separate the en-route sector from the lower sector, thus providing a combined en-route and arrival/departure function.

Diagram 2-6

METHOD 2A

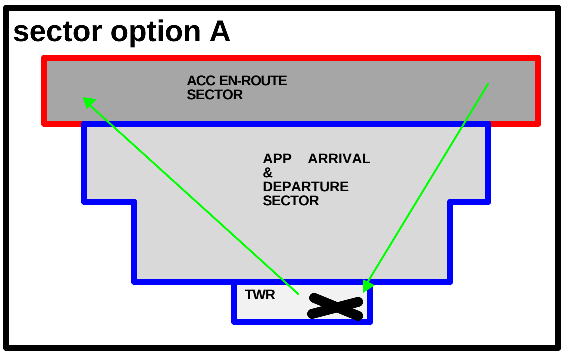


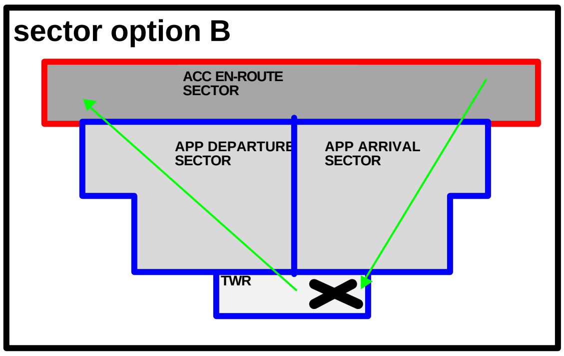


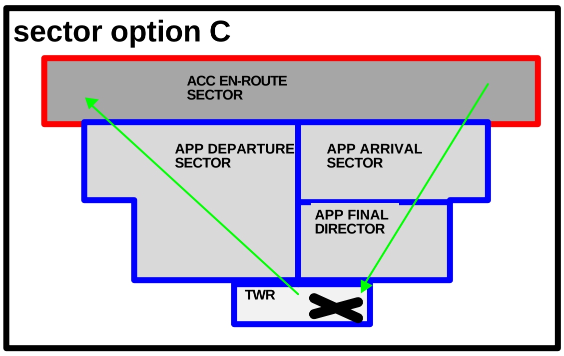


At low traffic density, the need for sectorisation may not occur. The sectorisation equates to the functional division chosen (option A). As the traffic density increases the need for sectorisation within the area of responsibility of the ACC occurs. This may be divided into arrival and departure tasks (option B) or en-route and arrival/departure tasks (option C).

METHOD 2B



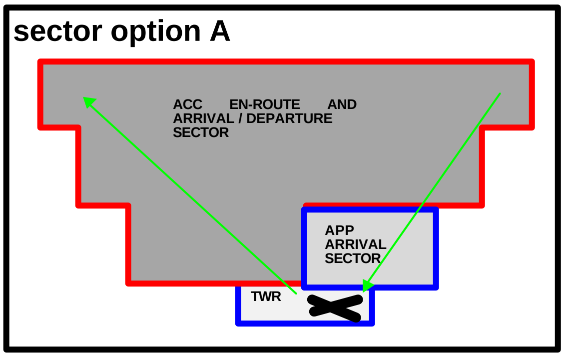


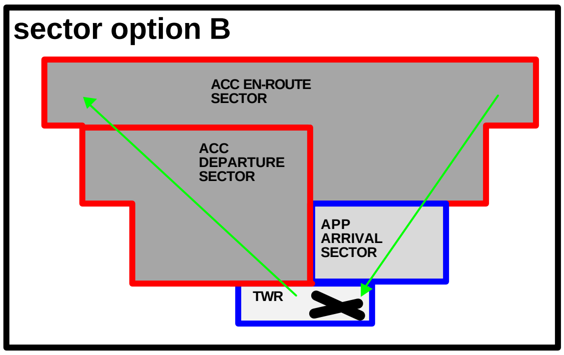


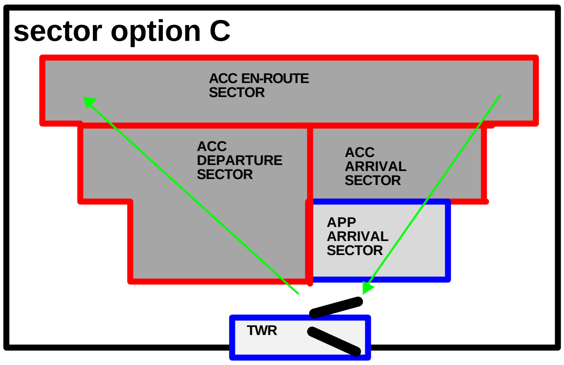
At low traffic density, the need for sectorisation may not occur. The sectorisation equates to the functional division chosen (option A). As the traffic density increases the need for sectorisation within the area of APP responsibility occurs. This may be divided into arrival and departure tasks (option B) or division of the APP arrival tasks (option C).

Diagram 2-7

METHOD 3A

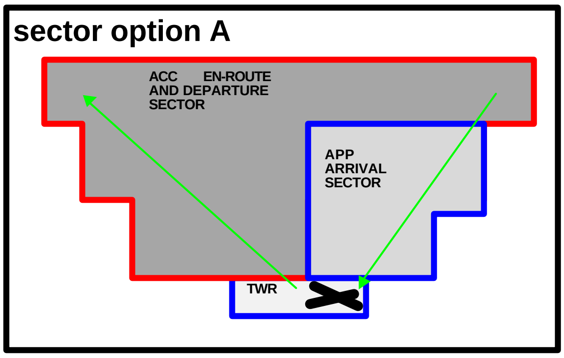


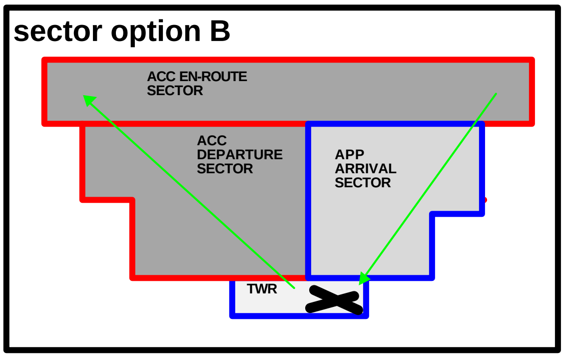


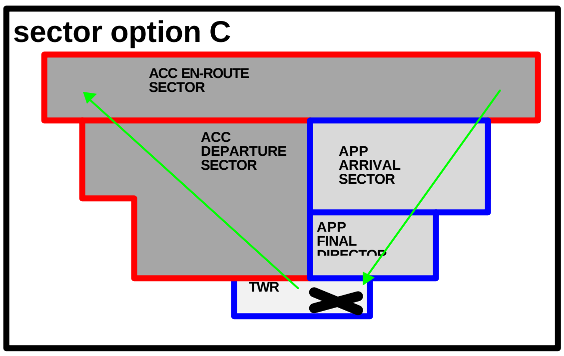


At low traffic density, the need for sectorisation may not occur. The sectorisation equates to the functional division chosen (option A) in which the APP unit has responsibility for only the final vectoring tasks. As traffic density increases the ACC enroute function is separated from the ACC departure function by the creation of an ACC departure sector (option B). At high traffic density an ACC arrival sector is introduced to separate the ACC arrival function from its enroute responsibilities (option C).

METHOD 3B







At low traffic density, the need for sectorisation may not occur. The sectorisation equates to the functional division chosen (option A) in which the APP unit has extended responsibility for the arrival phase. As traffic density increases the ACC enroute function is separated from the ACC departure function by the creation of an ACC departure sector (option B). At high traffic density an APP initial arrival sector is introduced to separate the initial and intermediate arrival function from the final vectoring responsibilities (option C).

5.3.3.3 <u>Co-ordination Procedures Associated with a Divided Approach Function</u>

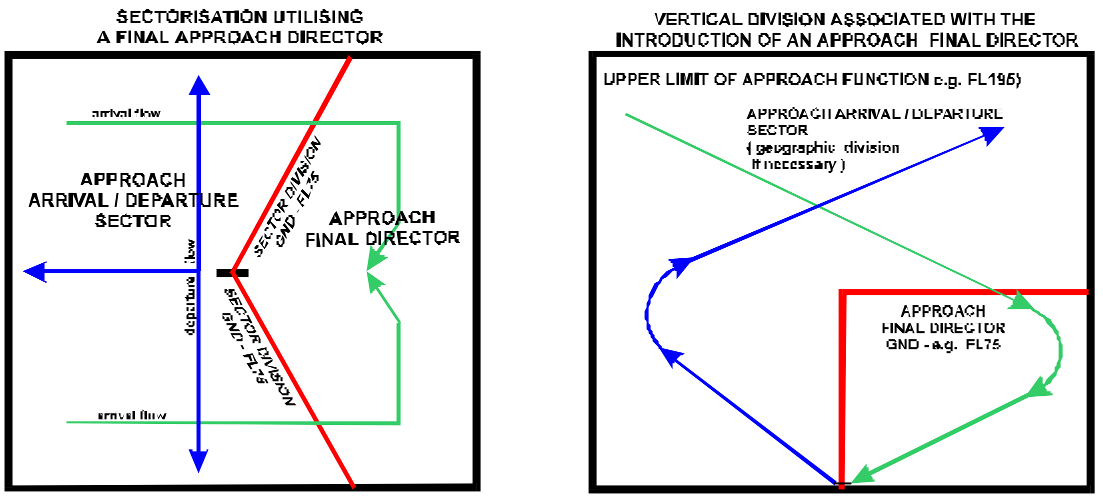
The Approach unit itself may be operated with separate sectors. These may utilise dynamic co-ordination agreements but, due to the relatively small area concerned and the need for multiple co-ordination, standard agreements are usually established.

Alternatively, it may be possible at some locations to divide the arrival and departure tasks *without the need for sectorisation.* This scenario requires highly active dynamic co-ordination to ensure separation is maintained. Careful consideration should be given to effective and efficient co-ordination between adjacent sectors, particularly when dynamic co-ordination will assist in supporting ATC capacity levels. Excessive co-ordination requirements may contribute to a reduction in sector capacity.

5.3.3.4 <u>Potential Sectorisation of the Approach Unit</u>

The division of the final approach sequence tasks from other approach tasks may be accomplished by the introduction of a 'final approach director' sector. This sector will be established according to the runway in use and will generally encompass airspace in the immediate vicinity of the final approach area. The vertical extent of such a sector is usually relatively low (e.g. FL75 - FL100). This enables the sector to be dedicated to the task of final approach sequencing without the interaction of other traffic in the terminal area. Diagram 2-8 shows a typical sectorisation in both the vertical and horizontal planes.

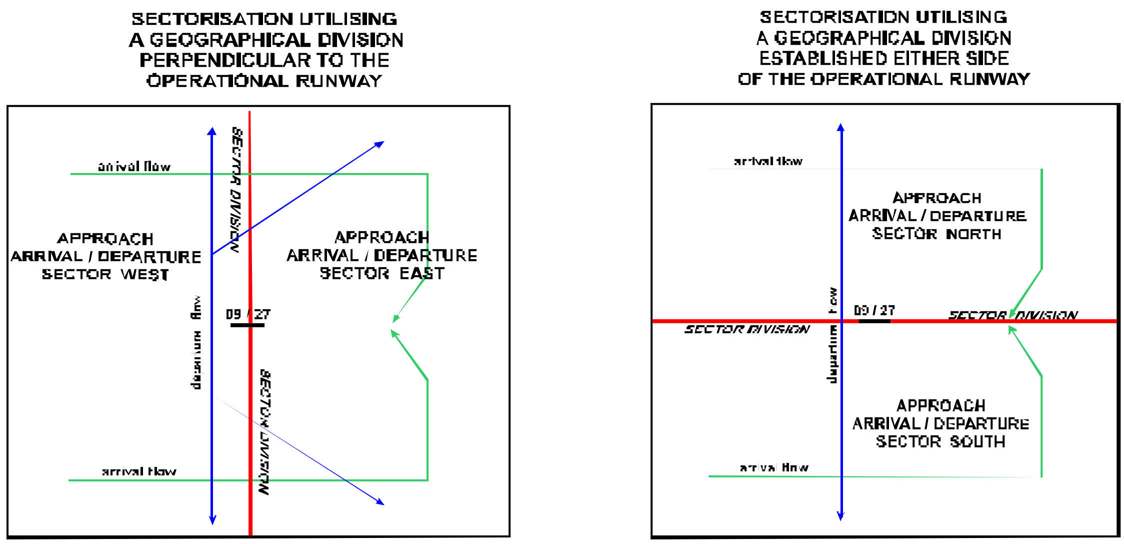
Diagram 2-8



The vertical limit of the area of responsibility for the final approach director will normally be established at a relatively low level (in this example FL75). This enables departing aircraft to climb above the area without interacting with the final sequence function.

Division of the approach unit tasks may also be introduced by geographic sectorisation. The structure of these sectors will be determined by the needs of a specific location. An example of such sectorisation is the division between operations on each side of the runway in use. In this example both sector controllers are responsible for arriving and departing traffic in their assigned sector. The division may also be established perpendicular to the runway in use. Both these options are shown in Diagram 2-9.

Diagram 2-9



Responsibility is divided between two sectors established either side of the operational runway or divided perpendicular to the operational runway . Both sectors are responsible for separation between arriving and departing traffic flows.

5.4 TERMINAL AIRSPACE DESIGN

5.4.1 The design of terminal airspace structures

It has already been established that terminal airspace structures may be identified in a number of ways. The ultimate aim of all of these structures is to provide a safe system of air traffic control for aircraft operating under Instrument Flight Rules (IFR) in the vicinity of the airport, or airports, concerned. The actual terminology used to identify this airspace is, for operational purposes, of little consequence. However, the design principles upon which this airspace is constructed are very important.

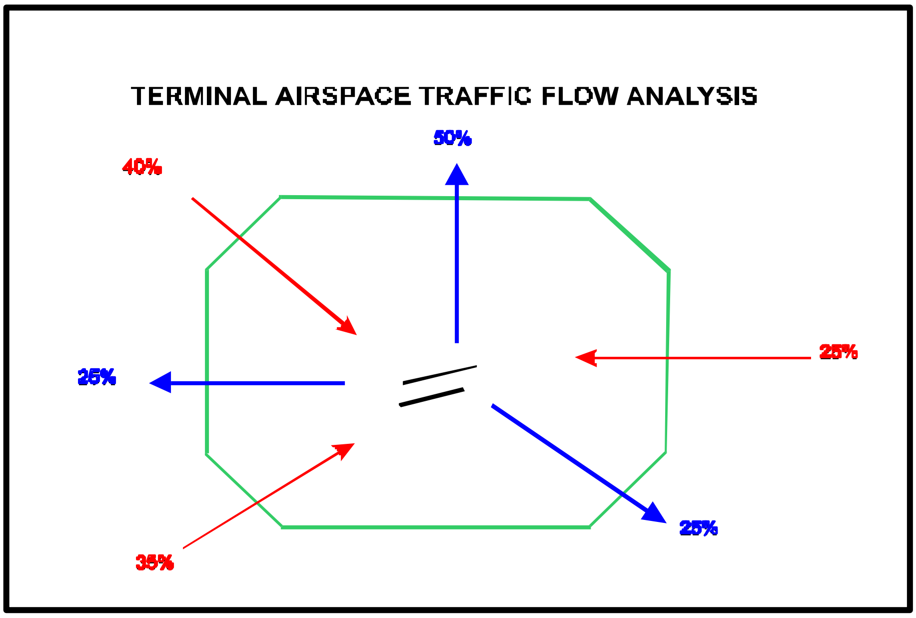
The principles of design of the airspace will have a large impact upon the methods used for separation within the airspace and, therefore, the associated airspace capacity.

As airspace structures have evolved over a number of years it is necessary to carefully analyse existing structures. This analysis should identify the airspace concerned for a specific location.

5.4.1.1 Assessment of Traffic Flows

An assessment of existing traffic or anticipated traffic flows is an important process in the initial stages of terminal airspace design. The characteristics of the traffic flow (bi-directional, multi-directional, etc.) will influence the design and operation of the airspace to a large degree. The development of potential new routes should also be considered. A basic traffic flow assessment is shown in Diagram 3-1.

Diagram 3-1



5.4.1.2 Identification of Airspace in which Approach Control is Exercised

An analysis of aircraft flight profiles may be carried out in order to identify the area in which the approach function is provided. It is not the purpose to identify specifically the top of climb or beginning of descent as these points, in many locations, may be considered an area control function. Rather, it will be a site-specific decision which should take into account such issues as adjacent unit requirements, ACC sectorisation, etc.

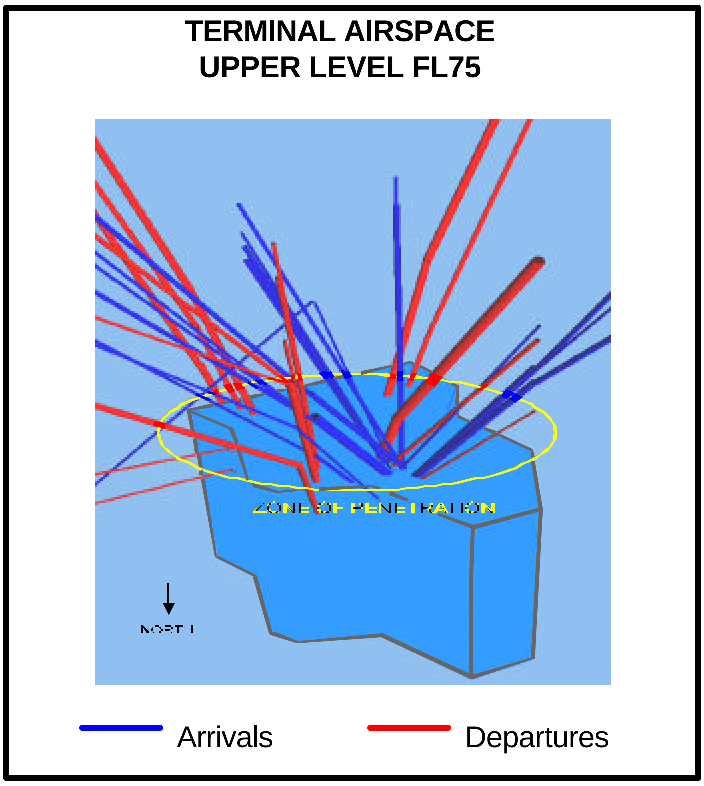
A flight profile analysis may consist of a computer-assisted visualisation of the airspace as shown in Diagram 3-2. This diagram depicts a terminal area with an upper limit of FL75. Optimised climb and descent profiles are shown. A comparison of both standard and existing operational profiles will indicate existing constraints upon aircraft performance although it cannot be stressed too strongly that, in order to utilise the full capability of this tool, it is necessary to view the results in 3-D format. However, if computer-assisted analytical tools are not available, flight profiles may be constructed manually.

5.4.1.3 Development of New Locations

In some locations the requirement for terminal airspace may be associated with a new airport development or the expansion of airport infrastructure at sites which have not previously served the type of operation envisaged. In this situation it is not possible to utilise an existing traffic sample to carry out a flight profile analysis or to determine traffic flow characteristics. When this occurs a traffic sample can be constructed utilising the aircraft types and routes that it is considered will form the basis of aircraft operations. In addition to flight profile and route issues, the requirement for navigation aids, the location of such facilities and other influencing factors, e.g. existing airspace constraints will determine the design of the terminal airspace.

When a new location is being developed it is important that reviews of the operation are carried out at regular intervals to ensure that the need for alteration of the structure, if required, is identified at an early stage.

Diagram 3-2



N.B. To gain the full benefit of a terminal airspace design tool it is necessary to view it in 3-D.

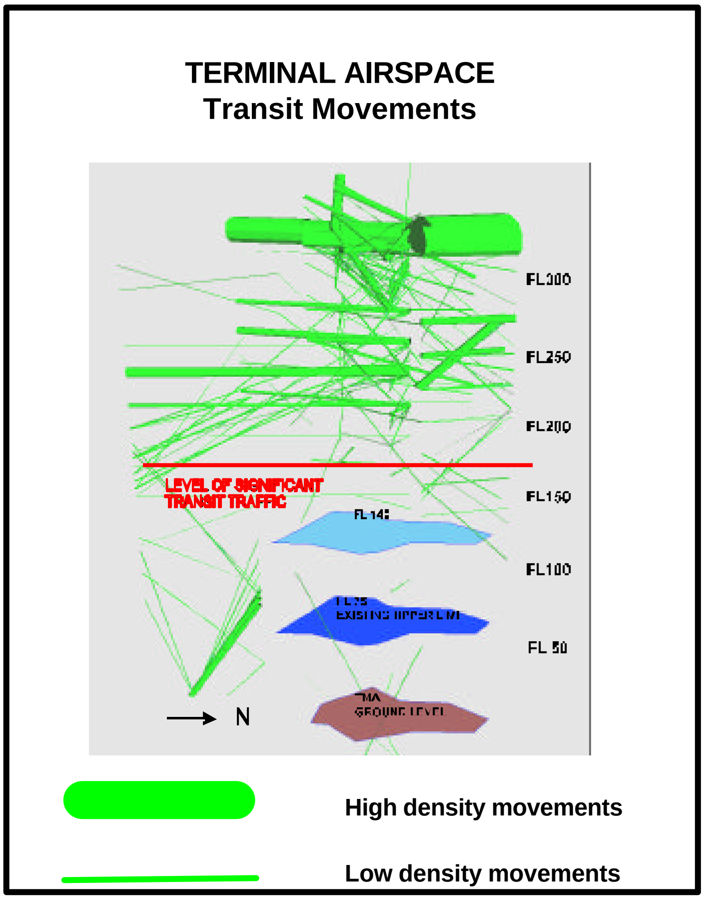
Arrival and departure flight profiles are shown in an optimised format. i.e. flights are considered unrestricted in both climb and descent. It can be seen that the majority of flights penetrate the upper horizontal surface of the airspace. This may be the required solution in certain cases. However, in other locations it may be preferable for flights to enter or exit the airspace via the lateral boundaries.

5.4.1.4 Identification of Overflying Traffic Flows

When designing the airspace in which the Approach function is to be carried out, an underlying principle should be to avoid the inclusion of overflying aircraft to the greatest extent possible. Therefore the identification of significant transit traffic flows is imperative. Again, computer-assisted tools may easily identify these traffic flows. Diagram 3-3 indicates a typical analysis of transit aircraft movements. In this example the existing upper limit of the terminal area is FL75. It might be considered that the terminal airspace management could be improved by raising this upper limit and the analysis shown here indicates that the upper limit may be raised as high as FL155 without introducing significant transit traffic flows into the terminal area.

In some locations restrictions are imposed upon aircraft wishing to transit via an area of terminal airspace. These restrictions may require the aircraft to route around or above the airspace in question. However, in many locations this is not considered an acceptable solution.

Diagram 3-3



The transit traffic analysis indicates that the majority of overflying aircraft are above FL165. Therefore when specifying the upper limit for the terminal airspace it should, in this instance, be no higher than FL155.

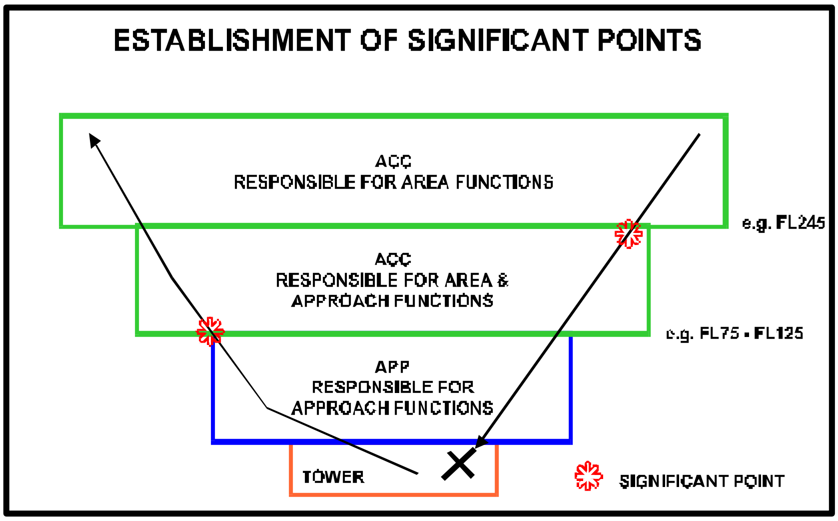
5.4.1.5 <u>Establishing the Connection with the En-route Environment</u>

The dimensions required for a particular area of terminal airspace may not be laid down in definitive documentation. However, the establishment of *significant points** at which it is considered that aircraft transfer from the en-route phase to the approach phase (and vice versa) for a particular area will assist in defining dimensions.

The choice of location for these *significant points* will depend to a large extent upon the selection of the terminal airspace *functional methodology* to be applied. The position of these *significant points* will not necessarily coincide with the top of climb or beginning of descent if this is considered to be an area control function at the given location. For example, if functional design Method 2A is selected, the location of the *significant point* may well be at an earlier stage of the departure route (e.g. between FL75 and FL125). The arrival route *significant point* may also be established at an earlier stage (e.g. at FL245). This is illustrated in Diagram 3-4 .

* ICAO definition - A significant point is a specified geographical location used in defining an ATS route or the flight path of an aircraft and for other navigation and ATS purposes.

Diagram 3-4



Significant points are established in this case at the transfer position between Approach Control and Area Control for departure flows. For arrival flows, these points are established at an earlier stage of flight. The Area Control lower sector commences the provision of the approach function and transfers aircraft to Approach Control at a later stage for final sequencing .

5.4.2 Operational practices within the defined terminal area

Operations within the area established as being associated with the APP function (i.e. that area contained within the confines of the defined *significant points)* will be associated with the aerodromes served by that terminal airspace. The operational practices utilised by the location concerned are dependent upon a number of factors. These include:

a. traffic density.
b. flow complexity.
c. type of aircraft operations.
d. local conditions and/or restrictions.
e. RNAV requirements and/or navaid infrastructure.
f. Other user activity (e.g. military requirements).

At many airports, notably those with a low density of aircraft operations, operational practices may be flexible with no formalised arrival (STARs) and departure (SIDs) routes established. At other locations and where appropriate, formal arrival and departure routes should be used. These can be published in the form of SIDs and STARs or by agreed operating procedures for controllers.

5.4.2.1 The Establishment of SIDs and STARs

SIDs and STARs should be established, when required, to facilitate:

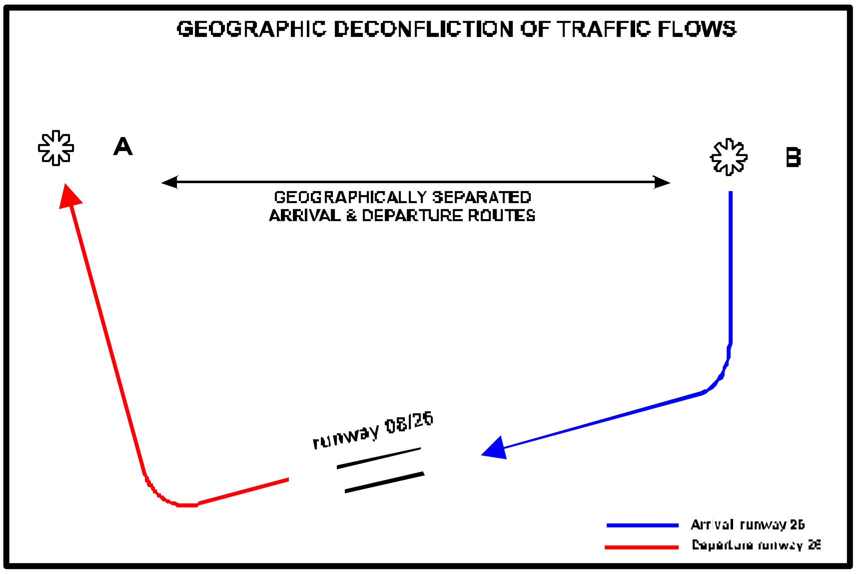
a. the maintenance of a safe, orderly and expeditious flow of air traffic.
b. the description of the route and procedures in ATC clearances.
c. the reduction of workload.
d. the potential for an increase in capacity.
e. the coding of navigation databases.
f. the support of modern flight data processing systems.

Generally, such routeings are established at the busier locations where the traffic flows are complex. Where possible, such routes should be strategically deconflicted. This may be achieved on a *geographic* basis or on a *vertical* basis or by a combination of both methods. The goal of strategic deconfliction is the operation of a steady and routine stream of arriving and departing aircraft, thereby providing for an overall increase in capacity. However, at many locations, capacity is further enhanced by tactical radar vectoring in order to 'fine tune' the traffic flows.

5.4.2.2 <u>Geographic & Vertical Deconfliction of Traffic Flows</u>

Geographic separation is established by deconflicting traffic flows on a *lateral* basis. This principle is shown in Diagram 3-5. The use of *geographical* separation may, in many cases, provide for an optimised aircraft performance. This is due to the fact that climb and descent profiles will not be interfered with to a great extent. However, the application of *geographic* separation may result in extended track mileage for arriving or departing aircraft.

Diagram 3-5

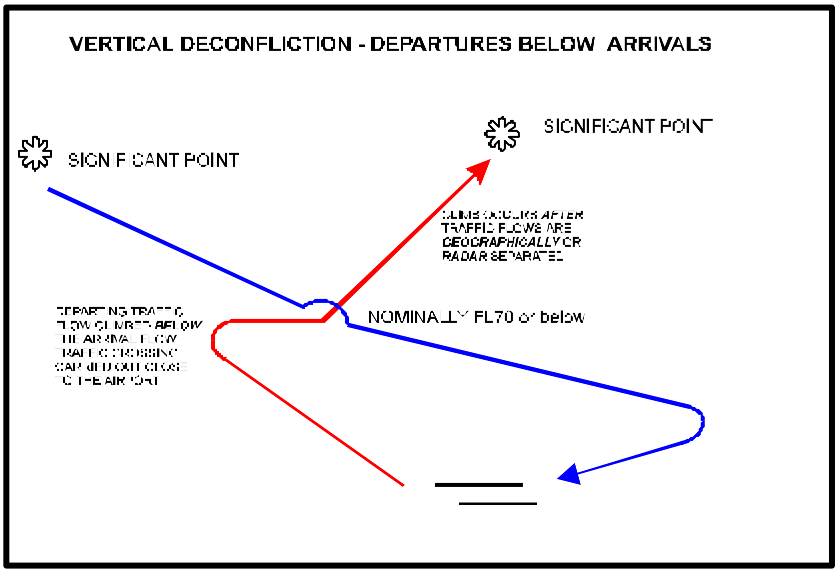


Geographic separation is established by locating the significant point B in a position which is laterally displaced from significant point A by such a distance as to ensure that the associated traffic flows do not interact.

The use of *vertical* separation may allow for more direct routeing and thus reduced track mileage compared to the use of *geographic* separation. However, climb and descent profiles may be compromised. This may be minimised by analysing traffic flow confliction points and associated levels.

When considering separation of arrival and departure flows by *vertical* means, it must be determined at what distance from the airport concerned the traffic flows will cross. This may be close to the airport and, in consequence, the departing traffic will be restricted to a level below that of the arrival traffic. In this case, the vertical division will be determined on a local basis but, in general, the crossover point will occur at FL70 (nominally) or below. This is indicated in Diagram 3-6. In some cases it may prove an advantage to arrange the arrival tracks to route *overhead the airport*. This may allow an unrestricted climb for departing aircraft.

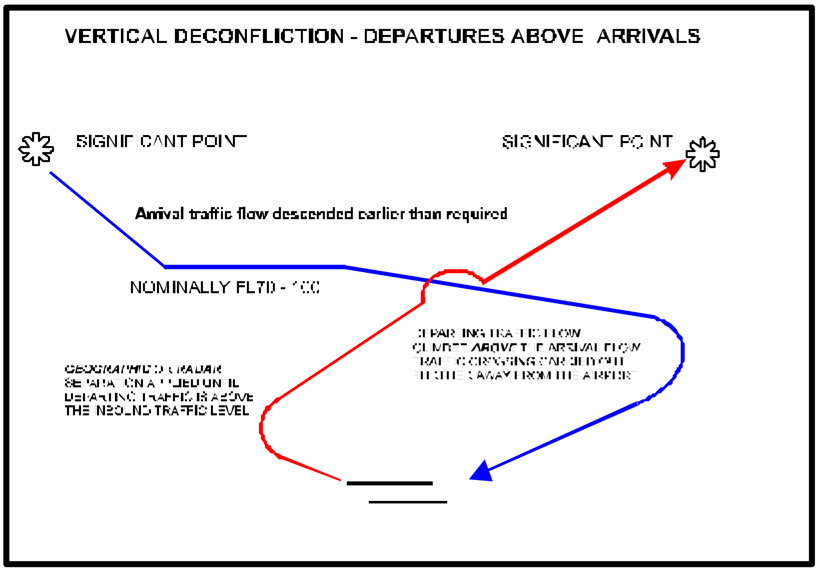
Diagram 3-6



*Vertical deconfliction, in which the departure traffic is restricted to a level **below** that of the arrival traffic, may occur close to the airport concerned or at some distance away from that airport. This will be determined on a local basis. If the crossover point is some distance from the airport, the optimum climb performance of departing traffic may be compromised. Nonetheless, the optimum descent profile of arriving traffic may be achieved in some cases.*

If the crossover point is at some greater distance from the airport, the possibility of departing traffic being climbed *above* the arrival flow may be considered, as shown in Diagram 3-7.

Diagram 3-7



*Vertical separation may be obtained by climbing the departure traffic **above** the arrival flow. This occurs generally some distance away from the airport concerned in order to ensure that the climb performance of departing traffic is sufficient to guarantee vertical separation at the crossover point. Although the climb performance of departing traffic may be optimised, arriving traffic descent profiles may be compromised due to the requirement for early descent.*

The performance of the aircraft concerned must be considered when determining the method to be utilised. If a choice is made to restrict departing aircraft to a level below that of arriving traffic this should normally be carried out close to the airport concerned to minimise the effect on aircraft climb and descent performance. The determination of the area for such a crossover will be influenced by local conditions. However, in order to allow sufficient time and airspace for the further descent of arriving traffic to final approach a crossing towards the start of the downwind leg may be beneficial.

If it is decided to climb departing aircraft above the arrival traffic flow, it is necessary that the area for such a crossover point is established in a location that will ensure that the climb performance of departing aircraft is sufficient to ensure that vertical separation will exist at the point of crossing. A crossover towards the end of the downwind leg may in this instance be advantageous, allowing a greater track mileage for departing aircraft to achieve the higher level required for the crossing. Correspondingly, arriving traffic will be at a lower level in this area.

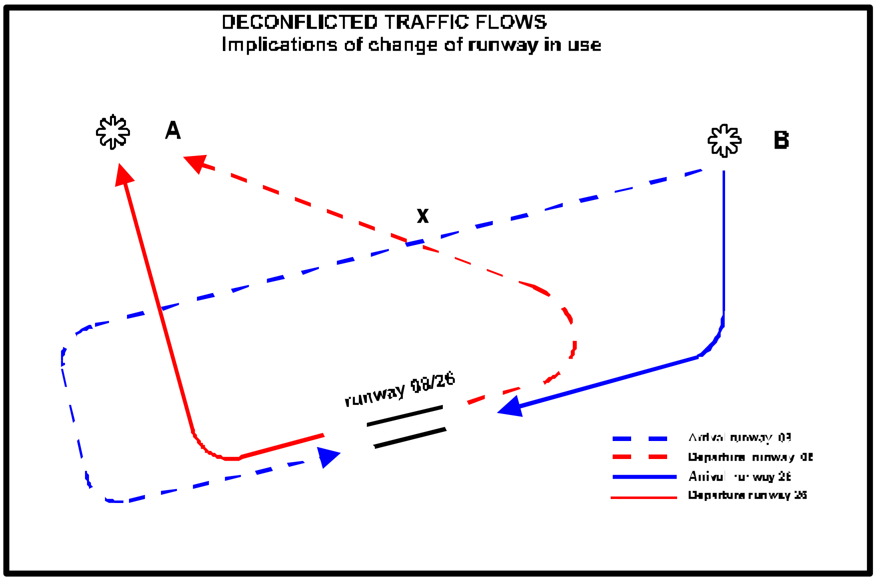
5.4.2.3 Preferential Runway Requirements

The majority of airports have a preferential runway system. The determination of this preferential runway may be dictated by factors such as:

a. prevailing wind conditions.
b. environmental considerations.
c. provision of approach procedures.
d. terrain.

The preferential runway may be in use for a significant majority of the time and traffic flows will, in the main, be developed to optimise operations on that runway. When operations revert to a runway other than the preferential runway, they may be made more difficult and less efficient due to the introduction of conflicting traffic flows etc. Terminal airspace should ideally be designed so that capacity is maintained whichever runway is in use. One method of achieving this is to move towards a design in which traffic flows separated geographically revert to vertical separation and vice versa as runway operations change. This is shown in Diagram 3-8. However, many influencing factors such as environmental considerations will mitigate against this principle.

Diagram 3-8



When runway 26 is in use, traffic flows via point A & B are separated geographically. When operations revert to the reciprocal (runway 08) the traffic flow is separated on a vertical basis at point X.

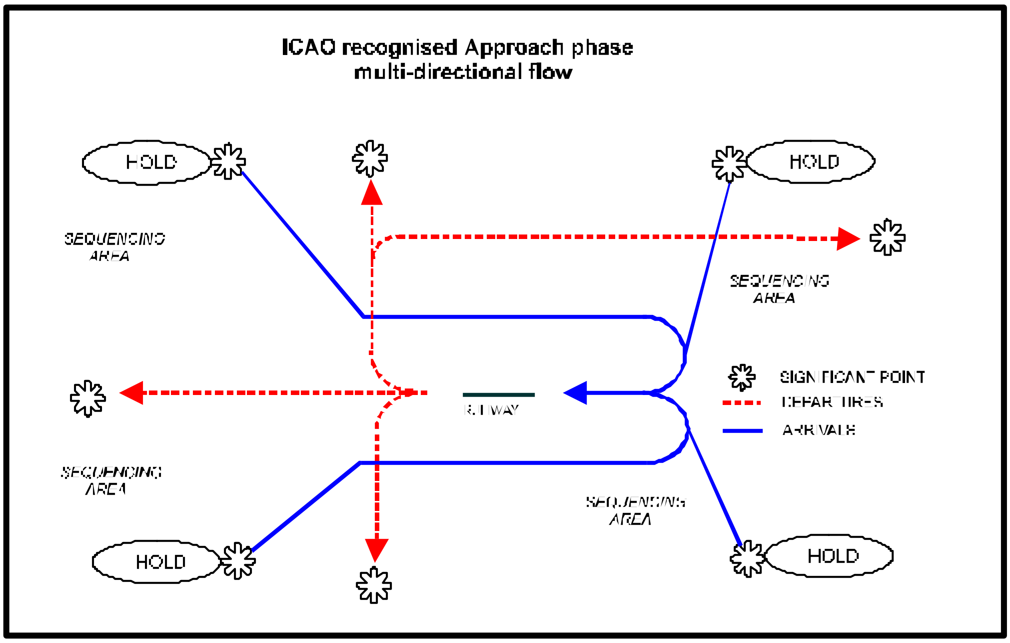
N.B. The significant points A & B remain the same in both operational directions.

5.4.3 Idealised location of the significant points

5.4.3.1 <u>The Four Post Multi-Directional System</u>

In a theoretical environment in which traffic flows arrive and depart from a number of directions the airspace design, based upon the deconfliction of traffic flows by vertical or geographical means, may tend towards a *four post* system in order to incorporate the principles of strategic deconfliction. This is illustrated in Diagram 3-9. This provides for a sequencing area prior to the arriving aircraft entering the traffic pattern associated with the runway in use (downwind, base and final approach legs). This sequencing area is used to establish the desired landing sequence. *Significant points* associated with departing traffic flows are established between the arrival traffic flows.

Diagram 3-9

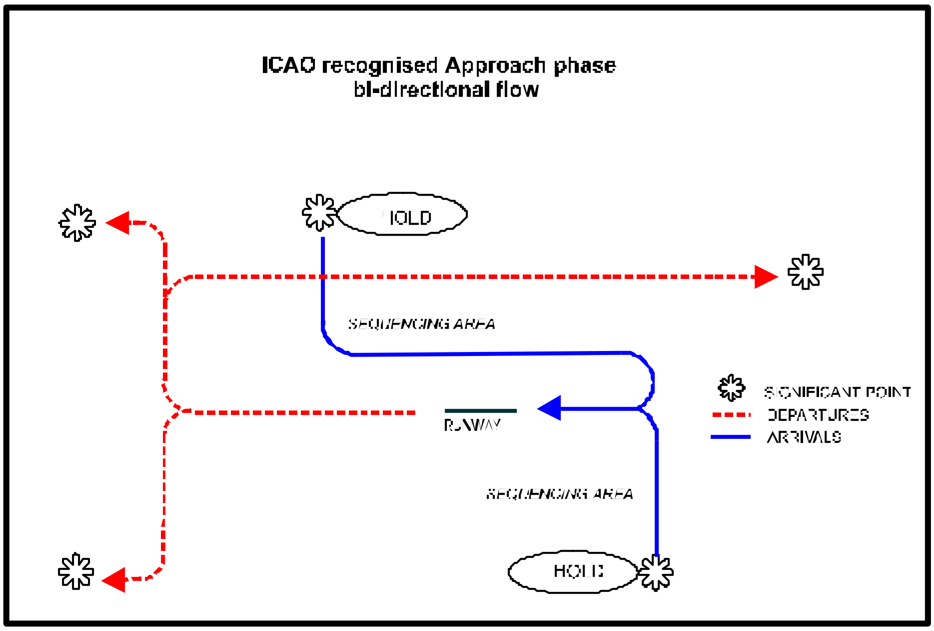


Significant points are established for arriving traffic in a four post geometry. This introduces a sequencing area prior to the arriving aircraft entering the traffic pattern associated with the runway in use. Significant points associated with the departure traffic flows are established between the arrival flows. This may be utilised at locations with multidirectional traffic flows and sufficient airspace availability.

The four post multi-directional system may be utilised when there is sufficient airspace available. However, in Europe, many locations have limited airspace availability. This limitation, together with other constraints such as traffic flows and runway geometry, will result in few locations being able to apply this concept in its entirety.

The four post multi-directional system may be varied by introducing a two or three post system where traffic flows and constraints dictate that this is the preferred option A bi-directional system is illustrated in Diagram 3-10.

Diagram 3-10



Significant points are established for arriving traffic in a two post geometry. This introduces a sequencing area prior to the arriving aircraft entering the traffic pattern associated with the runway in use. Significant points associated with the departure traffic flows are established between the arrival flows. This may be utilised at locations with specific traffic flows or when there is limited airspace availability.

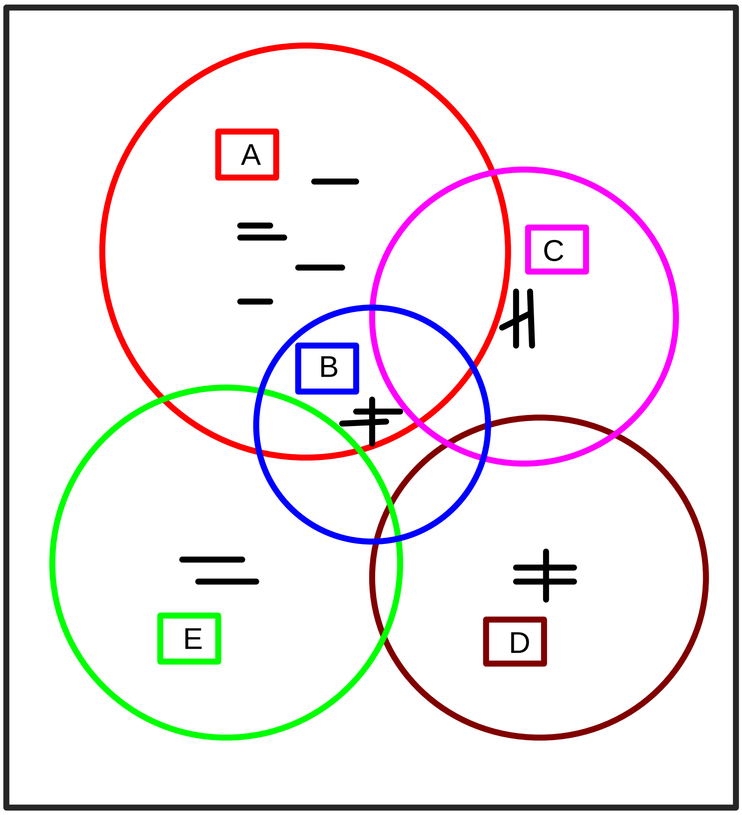
5.4.3.2 Establishing a Consistent Relationship with the En-route Environment

Altered traffic flows within terminal airspace when runway changes occur are, to a large degree, inevitable as the traffic origin/destination requirements will remain the same no matter which runway configuration is used. It is generally desirable that the choice of runway in use at an airport and the consequential utilisation of SIDs and STARs should be neutral in impact on the en-route system. Therefore traffic flows entering or leaving the terminal area *beyond* the defined *significant points* should ideally remain constant and should not be determined by internal terminal airspace traffic flow requirements. The rationale underlying this is that the change of traffic flows caused by a switch of runway would introduce a level of non-standardisation and unpredictability into the en-route system. This, in turn, could adversely affect en-route sector capacity and require variable flight plan routeing.

5.4.4 Zones of interaction

It is evident that the redesign of an individual area of terminal airspace may have implications for other areas of terminal airspace in the immediate vicinity, as shown in Diagram 3-11. What is not so obvious is that this impact may extend to operations in areas some considerable distance away. The extent of this influence is an unknown factor, but will be a function of traffic (the number of airports within the airspace, the number of runways associated with these airports, etc. being influencing factors). For example, the area of influence of Amsterdam Schiphol airport is considered to be in the region of 100 NM (source: Director Operations Schiphol ATC). Even more complex multi-airport airspace may well exert influence as far away as 200 NM or more.

Diagram 3-11



Zones of Interaction are shown as circular for diagrammatic reasons only. The actual area of interaction will be determined by airspace operations and design.

The implications for such a concept are important for areas in which the *significant points* overlap. The internal traffic flow operations of one area will be linked to the operations of other overlapping areas. The actual route of aircraft proceeding from one such airspace may be determined by the utilisation of runways at aerodromes associated with other overlapping terminal airspace. In this situation, close co-ordination in planning and operations is vital in order to integrate the systems in an efficient manner. In such locations the application of ICAO Standards and Recommended Practices should be harmonised where possible.

5.4.5 Delegation of ATS

5.4.5.1 The Principles of Delegation of ATS

The delineation of airspace should be related to the need for efficient service rather than to national boundaries. Many areas of terminal airspace are located adjacent to a national boundary. To provide an optimised airspace design in this circumstance it may be necessary for the operations of a State's air traffic services to extend into the territory of the adjacent State. ICAO makes provision for this situation by the introduction of the concept of Delegation of Air Traffic Services. Guidance on the basic principles of Delegation of Air Traffic Services is given in Annex 11 to the Chicago Convention. (see Section 6)

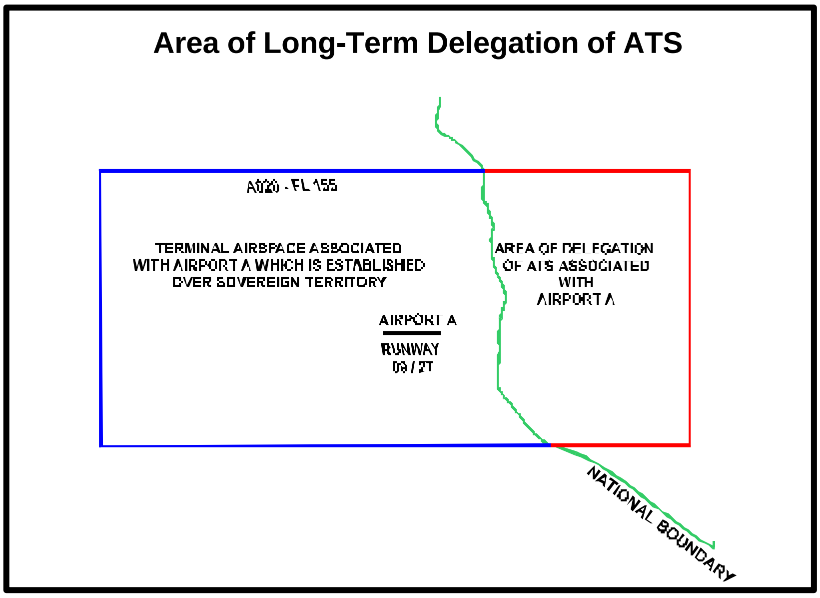
*N.B. It must be noted that generally the notion ' Delegation of Airspace' is **not** utilised as this may imply the transfer of sovereign rights associated with the airspace* *concerned.*

The concept of Delegation of ATS is intended to permit the delineation of airspace lying across national boundaries when such action will facilitate the provision of air traffic services. This may be established on a long-term or short-term basis.

5.4.5.2 Long-Term Delegation of ATS

Delegation of the responsibility for the provision of ATS to another State can be agreed on a long-term basis as illustrated by Diagram 3-12. The availability of the airspace concerned will not be withdrawn or the conditions for use modified without prior consultation with the providing State. Operationally, the airspace appears as an integral part of the terminal airspace that the delegation is intended to facilitate. In the situation where a State delegates to another State the responsibility for the provision of ATS in a portion of the airspace above its territory on a *'long-term'* basis, both the Delegating and Providing State should publish all relevant information regarding the portion of airspace concerned in their national AIPs.

Diagram 3-12

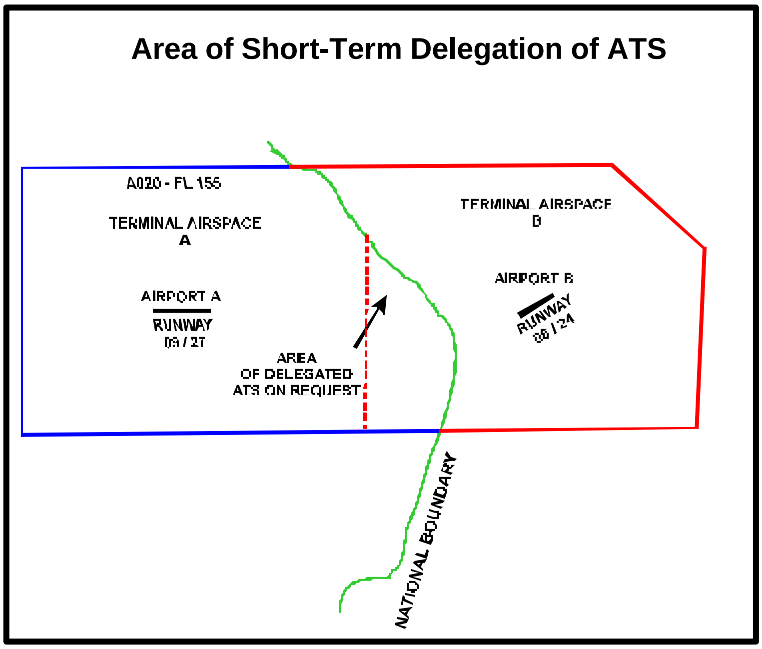


An area in which Delegation of ATS occurs is agreed between both parties for operational benefit of airport A. This area of delegation is published in aeronautical information as being an integral part of the terminal airspace concerned with airport A.

5.4.5.3 Short-Term Delegation of ATS

Delegation of the responsibility for the provision of ATS to another State can also be agreed on a temporary basis as shown in Diagram 3-13. The availability will be for a limited period of time as determined by both parties. This principle may be associated with a specific situation e.g. the use of a particular runway. In the situation where a State delegates to another State the responsibility for the provision of ATS in a portion of the airspace above its territory on a *'short-term'* basis, information relating to the portion of airspace concerned *may not necessarily be published in national AIPs.*

Diagram 3-13



An area of temporary delegation of ATS is agreed between both parties for the operational benefit of terminal airspace B when it is operating on runway 06. This allows for additional radar vectoring area for inbound aircraft to airport B.

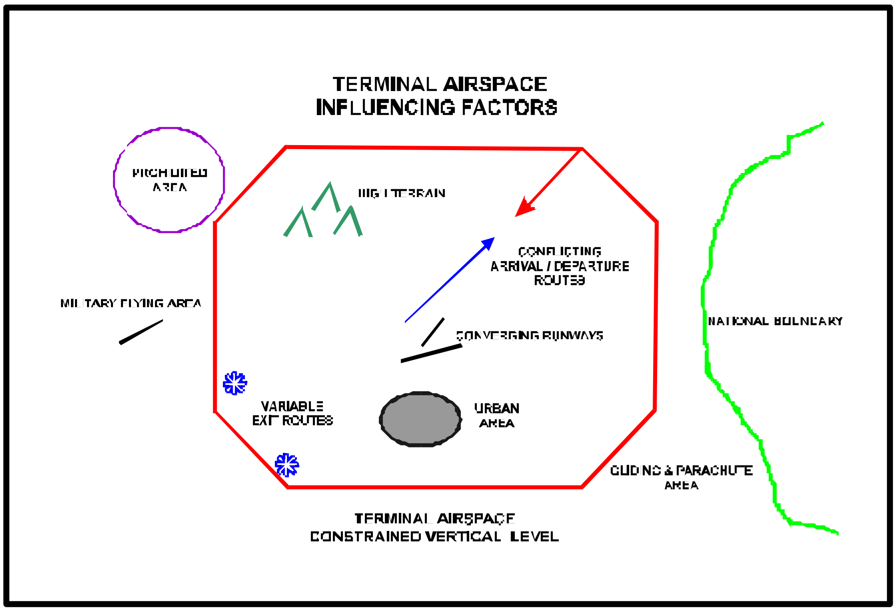
5.4.5.4 Zones of Interaction and Delegation of ATS

The principles involved with Delegation of ATS may also be associated with the concept of the Zones of Interaction in which the operations of one airport are directly affected by the proximity of another airport. An analysis based upon the Zones of Interaction concept may identify areas in which Delegation of ATS may enhance operations of one, or more, airports.

5.5 INFLUENCING FACTORS & IDENTIFIED PROBLEMS

There are a multitude of influencing factors with regard to terminal airspace design and management. The number and effect of these factors will vary from location to location. However, a *general* view of potential influencing factors and associated problems may have validity. In many cases, capacity-restricting factors may be found to originate from a source significantly different from that first presumed. Some of these constraints are studied below and illustrated in Diagram 4-1.

Diagram 4-1



Type of constraint affecting terminal airspace	Effect of the constraint upon terminal airspace operations	Potential solution to alleviate the constraint (not prioritised)
Airport Geometry		
Insufficient parking area or airport terminal capacity.	Landing restrictions imposed leading to holding delays & airspace congestion.	1. Additional infrastructure development. 2. Introduction of flow control measures.
Incomplete or non-optimised taxiway system.	Increased Runway Occupancy Time leading to increased separation on final approach.	1. Additional taxiway provision. 2. Introduction of other available runway options.
Converging and/or intersecting runway approaches.	Increased final approach separation in IMC conditions.	1. Introduction of Converging Runway Display (CRDA). 2. Development of independent converging runway approaches. 3. Deconfliction of missed approach procedures.
Use of secondary runway - other than the reciprocal.	Requires sector alteration within the terminal airspace leading to reduced capacity.	1. Reconfiguration of sectors. 2. Introduction of greater flexibility in sector design.
Lack of approach aids (including lighting) associated with secondary runway.	Visual manoeuvring required resulting in increased separation.	1. Installation of approach aids/lighting for the secondary runway. 2. Explore the possibility of using non-ground-based systems.

Type of constraint affecting terminal airspace	Effect of the constraint upon terminal airspace operations	Potential solution to alleviate the constraint (not prioritised)
Parallel runway lateral separation distance below ICAO prescribed minima.	Inability to operate independent parallel approaches.	1. Implementation of ICAO requirements for parallel approaches to runways 1035 m or more apart. 2. Dependent parallel approach operations (i.e. use of diagonal separation on final approach to both runways). 3. Segregated operations of parallel runways.
Use of reciprocal runway to the main runway. N.B. main runway = the runway with the highest usage	SID/STAR design for the main runway is not compatible with operations on the reciprocal runway. This leads to reduced capacity.	1. Redesign of SIDs/STARs to provide a 'mirror image' structure. 2. Use of vertical separation rather than geographical segregation for reciprocal operations.
Use of reciprocal runway - lack of airspace availability.	Reduced airspace available for radar vectors and consequent airspace congestion as well as a reduction in the protection area available for procedure design.	1. Increase in lateral size & depth of terminal airspace. 2. Agreement with adjacent users for areas of 'dynamic airspace' to be provided.
Lack of runway capacity.	Resulting in holding delays, extended routeing & airspace congestion.	1. Construction of additional runway facility. 2. Utilisation of other airports in the vicinity. 3. Introduction of runway capacity enhancing procedures.* *e.g. reduced final approach spacing & anticipated separation.

Type of constraint affecting terminal airspace	Effect of the constraint upon terminal airspace operations	Potential solution to alleviate the constraint (not prioritised)
Multiple airports in close proximity to each other.	A non-integrated system leads to reduced potential capacity at one or more of the airports concerned.	1. Provide an integrated approach system for the appropriate airports. 2. Deconflict SIDs/STARs for the airports concerned. 3. Develop facilities at one location & close secondary airports.
User requirements		
Military flying area adjacent to the terminal airspace.	Reduced radar vectoring area available, leading to additional workload for the controller and airspace congestion. Extended routeing in order to avoid military area.	1. Introduction of the Flexible Use of Airspace principles. 2. Dynamic co-ordination introduced between appropriate civil & military ATSUs. 3. Adapt civil procedures to accommodate military use. 4. Relocation of military training areas.
Military flying area within the terminal airspace. (possibly due to a military airfield being located within the airspace concerned).	Restrictions imposed upon radar vectoring area imposing additional workload upon the controller as well as restricted aircraft manoeuvring ability.	1. Introduction of the Flexible Use of Airspace principles. 2. Integration of the civil & military ATSUs. 3. Relocation of military flying area. (possibly introducing an entry/exit lane to the military airport).

Type of constraint affecting terminal airspace	Effect of the constraint upon terminal airspace operations	Potential solution to alleviate the constraint (not prioritised)
Required access of VFR aircraft to the main airport within the terminal airspace concerned.	Reduces available runway capacity for commercial IFR operations. Increases airspace traffic density.	1. Provide an appropriate airspace structure in order that access is available with the minimum possible penetration of controlled airspace. 2. Introduction of specific VFR routes. 3. Relocate VFR operations to other adjacent locations.
Required access of VFR aircraft to a satellite airport within the terminal area.	Increases airspace traffic density & provides additional controller workload.	1. Provide entry / exit corridors and appropriate airspace classification.
Aviation sports activities within or adjacent to the terminal airspace.	Increased airspace density & sterilised areas of airspace.	1. Introduction of dynamic co-ordination between ATSU & sport organisation. 2. Relocation of sport activity area.
Different requirements of aircraft operators within the terminal airspace. e.g. aircraft with diverse performance capabilities.	Multiple requirements may introduce additional complexity into the airspace or prejudice other users.	1. Standardise all operations to accommodate all users. 2. Provide separate routeings for certain categories of aircraft. 3. Modify instrument approach procedures for certain categories of aircraft.
National boundaries		
The proximity of an airport to a national boundary.	Reduces the availability of terminal airspace resulting in reduced radar vectoring area and extended routeing.	1. Introduce the concept of delegation of ATS on a long-term basis. 2. Provide for flexibility of areas of airspace by temporary delegation of ATS.

Type of constraint affecting terminal airspace	Effect of the constraint upon terminal airspace operations	Potential solution to alleviate the constraint (not prioritised)
Within areas of airspace in which delegation of ATS occurs, different rules of the air and airspace classification are applicable.	Provides an uncertain basis for the provision of ATS. May introduce a more complex ATC environment.	1. Standardisation of airspace classification. 2. Introduce Letters of Agreement including delegation issues. 3. Clear identification of such differences in controllers' local operation orders.
The proximity of multiple airports separated by national boundaries.	Restricted terminal airspace availability. Complex co-ordination procedures leading to reduced airspace capacity.	1. Provision of a single multinational service facility. 2. Provision of an integrated airspace with separate ATSUs ensuring deconfliction of routes. 3. Introduction of the concept of delegation of ATS on a permanent or temporary basis.
Incompatible or incomplete data or communication exchange.	Additional co-ordination required leading to increased workload.	1. Introduction of compatible data or communications exchange links.
Inefficient airspace organisation due to national requirements.	Lack of radar vectoring area. Increased co-ordination requirements.	1. Introduction of the concept of delegation of ATS on a permanent or temporary basis. 2. Provision of a co-ordinated airspace design.

Type of constraint affecting terminal airspace	Effect of the constraint upon terminal airspace operations	Potential solution to alleviate the constraint (not prioritised)
Physical Location		
The proximity of an airport to high ground.	The restriction of arriving and departing traffic flows to particular tracks results in: a. extended routes b. no deconfliction of SIDs/STARs c. non-divergence of departure flows thus preventing the use of minimum departure separations.	1. Redesign of SIDs/STARs based upon new generation aircraft performance. 2. Introduction of routes based upon RNAV capability. 3. Utilisation of radar vectors for departing aircraft. 4. Introduction of procedures based upon visual reference.
Location in areas of adverse climatic conditions.	Inability to carry out an approach during adverse weather conditions, leading to holding delays & airspace congestion.	1. Reduced declared capacity. 2. Introduction of flow control measures. 3. Improved approach navigation aids. 4. Provide additional optimised holding facilities.
Environment		
Restricted operations imposed upon optimum runway configuration utilisation due to environmental considerations.	Optimum runway operations only useable during restricted times leading to reduced airport capacity and complex airspace operations.	1. Construction of new runway facilities for environmental reasons. 2. Prohibition of non-Chapter 3 aircraft. 3. Use of capacity-enhancing procedures.

Type of constraint affecting terminal airspace	Effect of the constraint upon terminal airspace operations	Potential solution to alleviate the constraint (not prioritised)
Mandatory Noise Preferential Routes.	Optimised departure route system not introduced due to noise constraints.	1. Introduction of more accurate track-keeping navigation systems. 2. Prohibition of non-Chapter 3 aircraft. 3. Introduction of specific routes for 'low environmental impact' aircraft. 4. Reassessment of SIDs/STARs taking account of new generation aircraft performance.
Inability to utilise a reciprocal runway due to environmental reasons. e.g. noise constraints.	If a preferential runway is used during tailwind conditions, increased final approach separation may be required. Utilisation of secondary (crossing)runway with associated potential reduction in capacity.	1.Use of continuous descent approaches. 2. Use of RNAV to avoid populated areas.
Route Structure		
No deconfliction of SIDs/STARs.	Resulting in multiple conflictions within the airspace and increased controller intervention.	1. Strategic deconfliction of SIDs/STARs on a geographic or vertical basis. 2. Increased use of standardised radar procedures.
Terminal airspace entry/exit points change according to runway in use.	Inability to standardise routes from terminal airspace which connect to en-route airspace. This causes flight plan inconsistencies and airspace planning problems.	1. Redesign SIDs/STARs to provide standard entry/exit points independent from runway utilisation/selection.

Type of constraint affecting terminal airspace	Effect of the constraint upon terminal airspace operations	Potential solution to alleviate the constraint (not prioritised)
Inconsistent requirements between airspace design and aircraft performance.	Conflicting requirements resulting in non-optimised operation & increased controller / pilot workload.	1. Reassessment of SIDs/STARs taking account of new generation aircraft performance. 2. Imposition of standardised requirements upon aircraft operators. 3. Better use of radar separation.
Design of SIDs/STARs for one runway inconsistent for use on reciprocal or secondary runway.	Results in multiple conflictions within the airspace and increased controller intervention.	1. Redesign of SID/STARs to provide a structure that is consistent for all runway configurations. 2. Revert from vertical deconfliction to geographical deconfliction when the reciprocal runway is utilised.
Use of the same routes by aircraft of different performance capability.	Delays introduced by less than optimal departure/arrival flow. e.g. slow speed aircraft operating on a specific SID followed by a high speed aircraft on the same SID.	1. Increased use of radar intervention. 2. Introduction of conditional routes for certain categories of aircraft.
Staffing / Equipment		
Reduced availability of suitably qualified staff.	Reduced ATC capacity. Sector division not possible.	1. Train additional staff. 2. Redesign sectors to allow for any imbalance of staff.
Suitable equipment not available/unserviceable.	Non-optimal use of the available airspace. Increased spacing between aircraft.	1. Provide the required equipment and improve redundancy of systems. 2. Use other facilities (e.g. contingency arrangements).

5.6 METHODOLOGY FOR TERMINAL AIRSPACE DESIGN

5.6.1 Stage 1 – Problem assessment

Prior to initiating a terminal airspace design project it is necessary to determine the aim and scope for such a requirement. The airspace may be performing adequately and only require optimising or, alternatively, a problem may be identified*. The problem may be an existing one or be one which is anticipated to occur in the future due to increased traffic levels or altered traffic characteristics etc. Anticipation of problems requires that traffic demand is monitored and **traffic forecasts** are made.

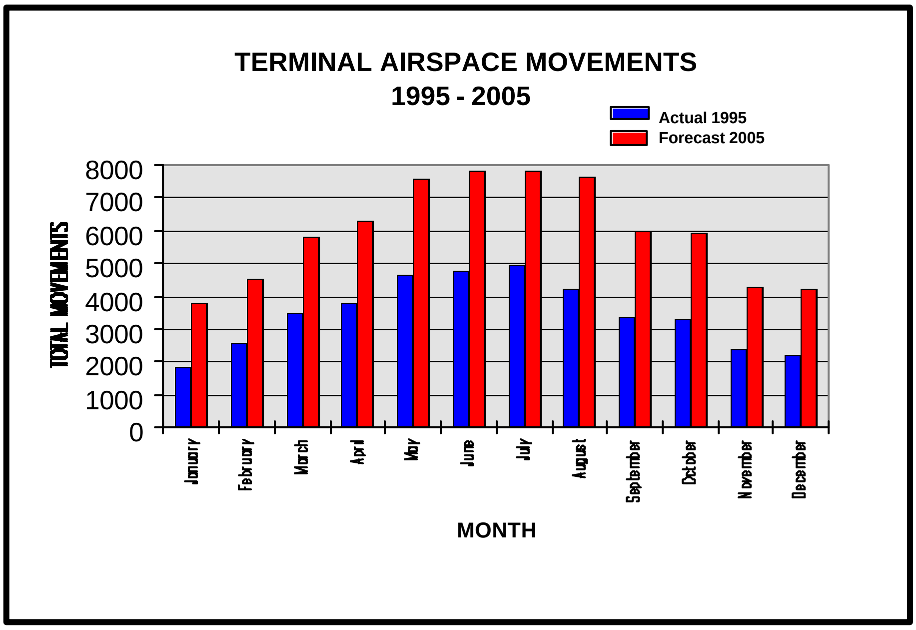
Monitoring of traffic demand requires that an accurate statistical data base is established to provide a basis for future planning. A further requirement is for a comprehensive analysis of existing traffic flows and forecasts which should include not only directional flow but also aircraft types and flight profile assessments.

* In a limited number of cases the airspace may be a completely new structure. However the methodology used remains the same.

5.6.1.1 <u>Forecasting Techniques</u>

A number of forecasting methods have been developed, ranging from simple forecasts based upon judgement to analytical model forecasts. Most techniques take account of economic, political, financial and competition factors**.** The actual method chosen will depend upon the available data types and sources. An example is given in Chart 5-1.

Chart 5-1



Forecasts may be on an aggregated basis or, to provide a more accurate pattern, a disaggregated basis. They should indicate changes in traffic demand on a seasonal, weekly or daily basis. In some instances, especially if demand is forecast to reach, or exceed, runway capacity, hourly forecasts may prove beneficial.

Forecasts must be re-assessed and adjusted at regular intervals to ascertain trends in the traffic pattern.

5.6.1.2 Performance Indicators

The performance of terminal airspace can be monitored to enable problems to be anticipated rather than react when they occur.

The development and use of *performance indicators* is a management tool which is widely employed in many industries. A system of indicators may provide early warning of likely problem occurrence. A well-established system of indicators may also identify areas in which problems are likely to develop e.g. shortage of runway capacity as opposed to airspace restrictions.

Most, if not all, areas of terminal airspace will benefit from the establishment of a system of performance indicators. Information gained from a simple system may well be as useful as that from a more complicated system, especially in a less complex terminal airspace environment.

A variety of sources exist for such performance indicators, some of which are shown below:

EUROCONTROL Central Flow Management Unit. * (CFMU) e.g. departure slot allocation	Regular reports are issued from the CFMU regarding areas in which significant delays occur.
EUROCONTROL Central Office for Delay Analysis. * (CODA) e.g. airport delay statistics	Reports are issued monthly indicating delay statistics based upon allocated departure slot times.
EUROCONTROL Central Route Charges Office * (CRCO) e.g. extended routeings	Records on the collection of en-route charges and associated city pairs may provide relevant information for traffic flow performance analysis.
International Air Transport Association. * (IATA) e.g operator complaints	IATA monitor delay statistics utilising disaggregated data thus providing method of identifying delays associated with air traffic control, weather problems, etc.
State Civil Aviation Authorities. e.g. airborne incident reports	Various statistics are published by Civil Aviation Authorities including airport movement comparisons, categories of aircraft, hazard reports, etc.
Airspace User Groups. e.g. general aviation reports	Users of the airspace may have formal or informal methods of recording data relevant to the performance of airspace.
Airport statistics. e.g. runway occupancy times	A variety of statistics are collated by airports. These include movements of all categories of aircraft, services provided, approach facilities utilised, environmental complaints, etc.
Controller associations. (e.g. IFATCA) e.g. controller workload	Many controller associations provide statistics and comment upon the performance and function of airspace. These may provide a basis for performance monitoring, especially with regard to human factors.

* mainly for use from a **MACRO** organisation level.

5.6.1.3 Examples of Problem Assessment

Airspace dimensions

The majority of terminal airspace areas have evolved over a period of time. However, in some cases these are based upon the requirements of previous generations of aircraft. Therefore it is necessary to reassess airspace dimensions with regard to existing aircraft flight profiles.

Standard Instrument Arrival / Departure Routes

The requirement for published SID's and STAR's is associated with the density and complexity of the terminal airspace concerned. At many locations with a low density of aircraft operations, published SIDs and STARs may not be necessary. In this situation a flexible system may be operated. As the density of aircraft movements increases, techniques to increase efficiency and contain (or reduce) workload may be required, as a result of which SIDs and STARs may be introduced.

Environmental issues

Environmental issues may, arguably, prove to be the most restricting factor in terminal airspace design. Flexibility for realigning traffic flows is restricted in many locations due to the requirement of Noise Preferential Routes. A number of other issues, such as the visual impact of aircraft and toxic emissions, are becoming more critical. Therefore consideration and monitoring of environmental issues is imperative.

Airspace classification

Airspace classification selection may significantly influence the capacity of terminal airspace. For example, within ICAO classification E controlled airspace VFR traffic does not require a clearance to enter, whereas in classification A airspace no VFR operations are allowed.
If airspace is not classified appropriately, or if ambiguity exists regarding the airspace classification, this may have an impact upon the operation of the airspace.

Airspace management

Aspects of airspace management practices should be constantly monitored to assess existing and future requirements. For example, changing political situations may introduce the possibility of the principle of the Flexible Use of Airspace being adopted to provide a more optimised terminal airspace structure.
Flow control measures may also require to be addressed. Airspace capacity should be monitored together with demand associated with the airspace in question. Demand in excess of given capacity may require flow management to be introduced.

Airport infrastructure & configuration

The provision of runways, their configuration and associated infrastructure is closely associated with airspace design. Excessive runway occupancy times, excess demand for runway slot allocation, delays caused by periods of poor weather conditions, require constant assessment in order to optimise capacity and efficiency.

Navigation aid requirements

Conventional standard instrument departure and arrival routes within terminal airspace require navigation with reference to ground-based radio navigation facilities. ICAO recommends that significant points be established by the siting of a radio navigation facility or the position defined in relation to a VOR or DME facility. The use of NDB bearings is kept to a minimum. Navigation aid provision and coverage require assessment if routes are to be realigned. The development of new generation navigation equipment may also introduce pressure for reassessment of existing airspace structures.

Terrain

At many locations terrain considerations will influence the design of terminal airspace to a large degree. The ability to introduce arrival and departure routes may be constrained due to the inability to provide the required obstacle clearance. Terrain features may also influence the position of ground-based navigation facilities which, in turn, may influence the design of SIDs and STARs.

5.6.2 Stage 2 – Project organisation

5.6.2.1 Organisation Perspectives

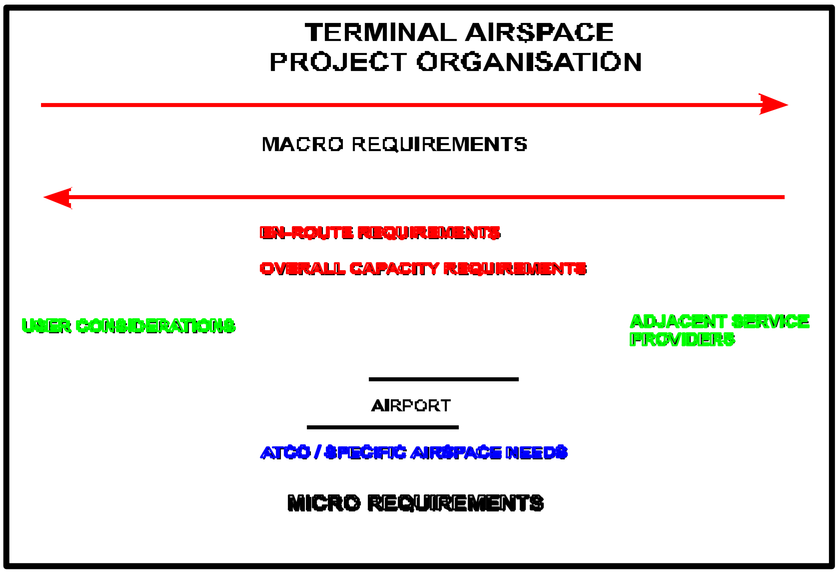
Organisation requirements will differ according to the individual project. However, the involvement of all interested parties at an early stage is imperative. Working arrangements may be organised from two perspectives, as shown in Diagram 5-2:

Macro level.
This examines the main flows of traffic within a multinational airspace system unconstrained by existing FIR/UIR boundaries or elements of a political nature. The associated interface with terminal areas is then addressed to accommodate, as far as possible, the requirements of the overall system. The benefit of this arrangement is that consideration is given to the wider picture beyond the simulated area which may enable harmonisation of routes with those in adjoining areas.

Micro level.
This requires input from those involved in the provision of the service, including air traffic controllers, airspace users etc.
The ultimate aim is to improve the structure of the individual area of terminal airspace concerned. This method is, in general, the most successful within the context of an individual area of airspace. However, if the development is taken in isolation, it is possible that it may be contrary to overall capacity enhancement. The principles of Zones of Interaction (see para. 3.4) should also be taken fully into account, with broad consultation among all relevant interested parties.

Clearly, both perspectives have limitations if viewed in isolation, and requirements for en-route development may be unachievable for a particular terminal airspace due to any number of reasons. However, the development of a specific area of terminal airspace without the consideration of other factors may lead to a fragmented airspace structure. Therefore it is important that full *consultation* takes place during an early stage of planning.

Diagram 5-2



5.6.3 Stage 3 – Proposal development

Proposal development should be based upon quantified problem assessment and may cover a number of areas. These will vary from project to project and a similar problem may result in different solutions being adopted in different States due to local requirements.

The following list outlines some of the elements that should be taken into consideration when developing improvement proposals for terminal airspace:

Design of Airspace
Airspace is a valuable asset which requires efficient management. Improved aircraft performance both in flight profile and navigation areas will enable new design concepts to be examined. The basic principle is to minimise the requirement for airspace restrictions consistent with the need for safety, while providing sufficient capacity to match the existing and forecast demand.
Traffic flows
Traffic flows interfacing with the en-route environment should provide a seamless transition and, ideally, allow for uninterrupted climb and descent with minimum intervention from air traffic control. Traffic flows should be designed so that the interface with the en-route environment is not dependent upon the runway in use at any given time. A 'mirror image' design may be the ultimate conceptual aim. However, in reality this is difficult to achieve due to the uneven directional traffic flow distribution at most locations.
Procedures
New procedures are being introduced in many locations in order to increase capacity at airports and in the surrounding airspace. A number of these are documented in the ECAC APATSI Manual on Mature Procedures. However it must be noted that these do not necessarily adhere to ICAO provisions. Note: Non-compliance with ICAO Standards and Recommended Practices should be filed as a difference with ICAO.
Airspace Management
The Flexible Use of Airspace (FUA) concept, endorsed by ECAC states, requires that airspace is considered as one continuum to be allocated for use to accommodate user requirements. This principle will result in more flexible structures being created to optimise the airspace design. This flexibility may be between civil and military users or between purely civil users when, for instance, airspace is allocated to a particular ATSU depending upon the direction of runway in use.
Flow control
Traffic demand and available capacity inevitably do not coincide during many periods. In order to balance demand with capacity during peak periods of the day, flow control measures may be introduced. In order to anticipate such a requirement, hourly forecasts must be analysed. A capacity assessment for airspace and associated airports is a prerequisite for the introduction of flow control measures.
Equipment
As the density of aircraft movements increases, the need to utilise advanced technology becomes more important. For example, in previous generations capacity within a low density area may have been adequate when controlled procedurally but as traffic increased the need for the introduction of radar became apparent. The introduction of new technology will require the development of complementary procedures.
Airspace users
The introduction of capacity enhancing measures within terminal airspace may require significant participation from the airspace users associated with the airspace concerned. In this case proposals may address the education of these users with regard to the flight techniques and operating procedures to be utilised within the airspace. Other airspace users, e.g. State aircraft, will require handling which takes account of the capabilities of their aircraft.
Environmental and other restrictions
Airspace restrictions may occur for a number of reasons e.g environmental considerations or the establishment of prohibited areas for national security reasons. Many of these restrictions cannot be removed and, therefore, innovative solutions must be found that will allow for optimal aircraft operations while adhering to the requirements imposed upon the airspace.

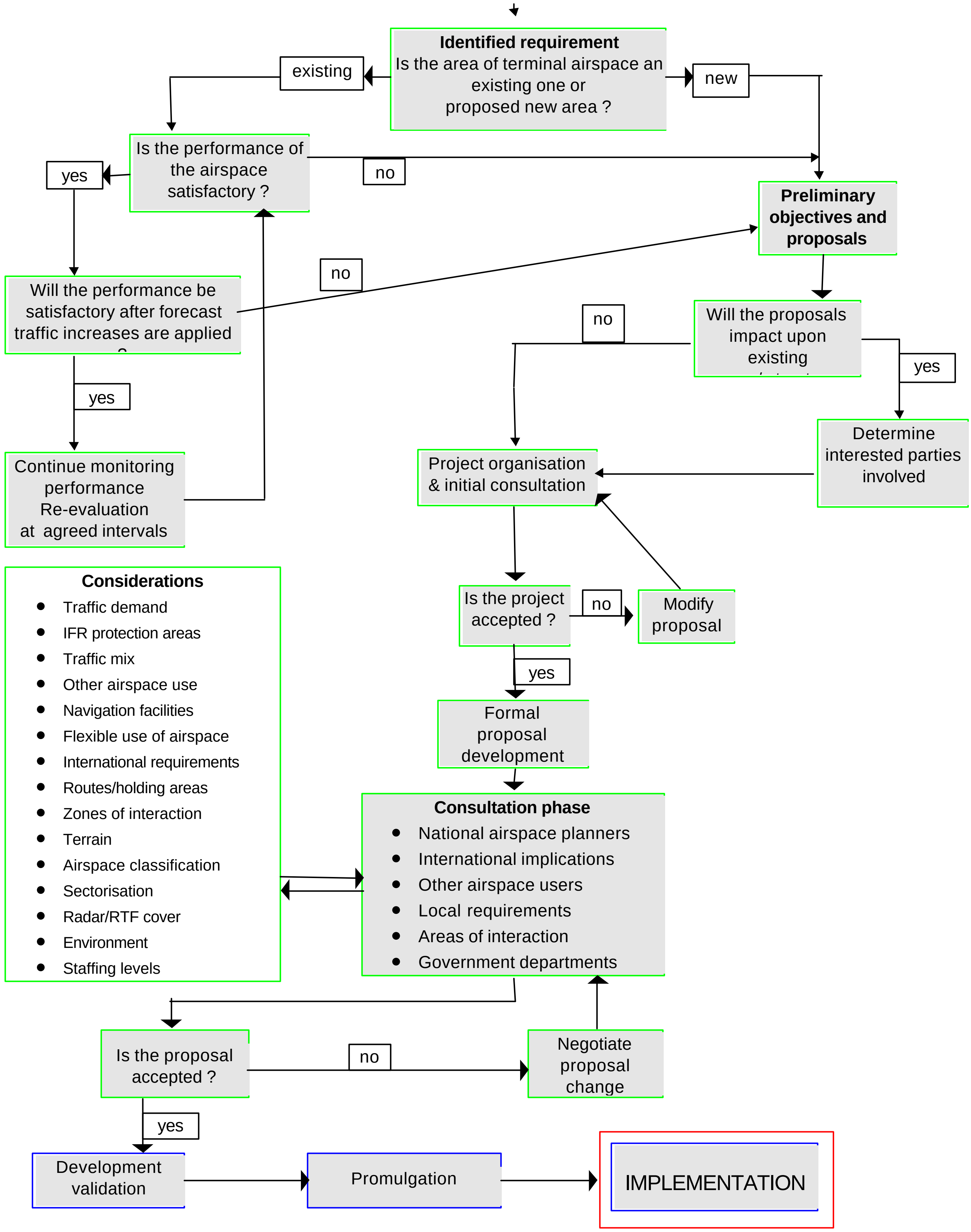
5.6.4 Stage 4 – Validation of proposals

Validation is usually required prior to implementation of proposals. Validation may be carried out by simulation (fast-time and/or real-time) or by analysis of trials and/or implementation at other locations. However, if proposals are considered as refinements of the existing structure or system, validation prior to introduction may not be considered necessary.

If simulation is chosen as the validation method, a *staged approach* is recommended. In general, the most successful validation arises from real-time simulation. However, the required resources for such a simulation are extensive. A high level analysis of a wide range of options may be available as an initial simulation level. Though lacking the use of in-depth information, these should enable options which are obviously not viable to be discounted at an early stage and therefore avoid the need for unnecessary additional resource-intensive simulation. In order to maximise available resources, a number of options may then be analysed by fast-time simulation and then preferred options selected prior to real-time simulation.

Staged approach	**Validation facility**
Refinement of existing structures or systems	If the proposal is considered as a refinement of an existing structure or system *it is possible that validation may be considered unnecessary.*
Existing procedures	Procedures in operation at another location. *Validation of procedures or concepts at another location may negate the requirement for a comprehensive simulation process.*
Initial evaluation of options	High level analysis tool utilising generic data or CFMU flight plan data. *Enables a number of options to be evaluated in order to discount those that do not have potential.*
Evaluation of viable options	Fast-time simulation utilising mathematical or analytical models. *e.g. SIMMOD, TAAM or RAMS.* *Enables analysis of potentially viable solutions in order to identify initial problems that may be encountered.*
Simulation of preferred options	Initiation of a real-time simulation. *This is resource-intensive and therefore should be used to evaluate only those options still considered viable.*
Site validation	Site validation may include flight trials of procedures or testing of structures that have been simulated or adopted from other locations.

5.6.5 A development process – Terminal airspace design concept



5.7 THE TERMINAL AIRSPACE CONCEPT

5.7.1 Overview of requirements

The needs of individual areas of terminal airspace within Europe are extremely diverse and, in consequence, a prescriptive terminal airspace concept cannot be applied. However, broad principles, based upon ICAO direction, may be established to serve as a platform on which an individual airspace structure may be designed. These principles have been discussed in preceding sections of this document.

5.7.2 ICAO Documentation

5.7.2.1 <u>ICAO Provisions</u>

The starting point for any terminal airspace concept should be the provisions contained within relevant ICAO documentation. As indicated previously, four separate issues should be considered:

a. Procedure design

The design of terminal airspace structures is closely linked to the associated departure, arrival and holding procedures established for the location in question. Controlled terminal airspace structures are provided to protect IFR flights during the arrival and departure phase. Therefore it is necessary for an airspace planner to have a comprehensive knowledge of the existing, or proposed, arrival/departure procedures for the location that the airspace structure will serve.

b. Airspace annotation

The terminal airspace concept should not necessarily be determined with reference to the annotation of the airspace structure concerned. However, the overall aim should be to establish controlled airspace so that it corresponds to the flight profile requirements of IFR aircraft which are to be provided with an ATC service. ICAO gives a number of guidelines on relevant structures. These may be summarised as:

Control Zones : Control Zones should be kept as small as possible, consistent with the requirement to accommodate the flight paths of controlled IFR flights between the lower limits of a CTA and the aerodrome for which the control zone is established.

Control Areas : Control Areas may be formed in a number of different ways in order to accommodate the flight paths of controlled IFR aircraft. These structures should supplement the associated Control Zone while keeping its lateral limits to a minimum.

c. Airspace function

The function of the airspace is of increasing importance with regard to capacity. In consequence, the identification of the airspace in which an APP function is provided is imperative. It is sufficient to stress that this function may be carried out by an ACC unit or an APP unit. As traffic density increases there may be the requirement to progress from one ‘function division’ to another. This will be determined on a local basis.

ICAO requires that *significant points* for arrival and departure routes are established at which the division of the en-route phase of a flight and the approach phase of a flight is made. This will be site-specific and may not coincide with the transfer of responsibility from an APP unit to an ACC unit or vice versa. The *significant points* for arrival and departure routes may also not coincide.

d. Airspace classification

Issues relating to the classification of airspace arise from the potential mix of IFR and VFR aircraft within the same area of terminal airspace. As traffic density increases there may be a requirement to introduce specific provisions for VFR operations. As traffic density increases further still, additional tightening of ATS provisions, for example segregation of VFR flights from IFR arrivals and departures, may be required. This may entail airspace re-classification.

5.7.3 The concept development

5.7.3.1 <u>Concept of Operations</u>

A number of steps must be taken in order to develop a concept of operations for a given area of terminal airspace. These steps will, in general, be similar for all locations. However, the final result may differ due to the local area requirements.

STEP 1. Capacity assessment *

Airspace planners should monitor the performance of the terminal airspace by establishing performance indicators. They should carry out a capacity assessment and apply forecasts in order to balance capacity with existing and forecast demand.

STEP 2. Traffic flow analysis *

Traffic flow analyses determine existing traffic flows and anticipated changes during the forecast period.

* If the development is a new location the capacity assessment and traffic flow analysis should be based upon predicted requirements.

STEP 3. Project development

The organisational requirements for development should be considered and all interested parties should be involved in order to help create a co-operative environment.

STEP 4. Airspace function and sectorisation

The functionality method to be used should be determined within the context of the specific requirements of the airspace. This will influence the choice of sectorisation option.

STEP 5. Airspace design

The area of the approach control function and the potential transit traffic implications should be identified.

STEP 6. Airspace operations

The need for the establishment of SIDs and STARs should be assessed. The internal terminal airspace traffic flows should be researched to ensure that the interface with the en-route structure is as consistent as possible.

STEP 7. Sectorisation requirements

The requirement for sectorisation of the approach control area of responsibility should be considered in association with the determination of the approach control functionality. This will be influenced by the methods adopted at the specific location.

STEP 8. Influencing factors

The influencing factors associated with the specific terminal airspace and the impact upon the airspace requirements should be assessed.

STEP 9. Establish connection with en-route

The location of *significant points* should be established and areas where they overlap should be identified.

STEP 10. Validation

The appropriate method for validation should be applied dependent upon the extent of reorganisation or development of the project.

STEP 11. Implementation and monitoring

Once the project has been implemented, operations should be continually monitored to provide an early indication as to whether amendments are required.

5.7.4 Conclusion

It has been reiterated in this document that terminal airspace design cannot be definitive. Each individual area must be seen to be unique in its own way. This document is intended to provide an outline of principles involved in terminal airspace design upon which the development of national documentation may be based. This national documentation may, more readily, address the specific requirements of the State concerned.

Airspace structures have evolved with time. This evolution will continue and will need to take account of new generations of aircraft with improved performance ability. Advanced navigation systems also provide the basis for redevelopment of airspace and may allow for more efficient airspace structures and operating procedures to be introduced. Therefore it is necessary for continuous reassessment of existing airspace structures based upon future requirements and the development of aviation technology.

SECTION 5

GUIDELINES FOR TERMINAL AIRSPACE DESIGN

FINAL PAGE

SUGGESTION - COMMENTS

To report any errors, or to propose a modification to the present Section 5 "Guidelines for Terminal Airspace Design", please contact:

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SECTION 5 - SPONSOR: ROUTE NETWORK DEVELOPMENT SUB-GROUP

Whenever material received, in accordance with the above procedure, makes it apparent that an amendment of the present Section 5 is required, such amendment will be first discussed within the Route Network Development Sub-Group (RNDSG) before its adoption by the Airspace & Navigation Team (ANT).

PUBLICATION OF AMENDMENT

The agreed amendment will then be issued by EUROCONTROL in the form most convenient for its insertion in the Planning Manual.

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SECTION 6

GUIDELINES FOR DELEGATION OF THE RESPONSIBILITY FOR THE PROVISION OF ATS

6.1 INTRODUCTION

6.1.1 Definition

6.1.1.1 As regards to the terminology describing the situation of one State delegating to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, two different expressions seem to be currently used.

6.1.1.2 In several bilateral agreements and corresponding documents the notion “delegation of airspace” is used. This notion would seem to imply that a State would transfer all responsibilities associated to the provision of ATS, including the regulatory competence, to another State which is in effect not the case.

6.1.1.3 So, a clear distinction should be made between "Delegation of Airspace" and "Delegation of the responsibility for the provision of Air Traffic Services":

- "Delegation of Airspace" will refer to the delegation of jurisdiction in a portion of the airspace over a territory from one State to another State with the transfer of all responsibilities associated to the provision of ATS, including the regulatory competence which may necessitate changes to FIR boundaries and/or imply derogation of national sovereignty.
- "Delegation of the responsibility for the provision of Air Traffic Services" will refer only to the delegation of the responsibility for the provision of ATS in a portion of the airspace over a territory from one State to another State.

6.1.2 Scope

6.1.2.1 The Delegation of Airspace is a very rare event requiring the approval of Governments concerned and ICAO, as it may involve changes to FIR boundaries. As ECAC States do not anticipate any such delegation in the foreseeable future, the Guidance Material in this Section 6 refers only to the Delegation of the responsibility for the provision of Air Traffic Services.

6.1.3 Process

6.1.3.1 The present Guidance Material is recommended to be used in conjunction with the Common Format, Cross-Border, Inter-Centre Letter of Agreement, Edition 2.0, REF: ASM.ET1.ST015, EUROCONTROL (hereinafter referred to as the **Common Format LoA**) for the purpose of describing the basic principles and operational aspects regarding the situation where one State delegates to another State the responsibility for the provision of ATS in a portion of the airspace above the territory of the former State.

6.1.3.2 The Guidance Material takes into consideration the provisions of the Model Agreement on the Delegation of Air Traffic Services developed by the Delegation of ATS Task Force, and approved by the EUROCONTROL Provisional Council. This type of Agreement between States, once implemented, takes precedence over any other lower level agreement, such as the Common Format LoA.

6.2 SOVEREIGNTY

6.2.1 According to the Convention on International Civil Aviation (Chicago Convention) "the contracting States recognize that every State has complete and exclusive sovereignty over the airspace above its territory. For the purposes of this Convention the territory of a State shall be deemed to be the land areas and territorial waters adjacent thereto under the sovereignty, suzerainty, protection or mandate of such State".

6.2.2 Based on the principle of the territorial sovereignty, it will fall under the jurisdiction of a State to prescribe the rules and regulations for the airspace above its territory. However, through signing the Chicago Convention, the States have undertaken to maintain, to the extent possible, their national rules and regulations in conformity with ICAO international standards and procedures.

6.2.3 In the Chicago Convention it is further prescribed that "any State which finds it impracticable to comply in all respects with any such international standard or procedure, or to bring its own regulations or practices into full accord with any international standard or procedure after amendment of the latter, or which deems it necessary to adopt regulations or practices differing in any particular respect from those established by an international standard, shall give immediate notification to the International Civil Aviation Organization of the differences between its own practice and that established by the international standard".

6.2.4 As a principle of sovereignty, the rules and procedures of the Delegating State apply in its territory. It is, however, actual practice to apply the rules and procedures pertaining to the provision of ATS of the Providing State. In the interest of safety and for the sake of efficiency, it is necessary that the air traffic controller is able to apply only one set of rules and procedures – those of the Providing State.

6.2.5 The rules and procedures pertaining to the provision of ATS in the Providing State shall apply when providing ATS in a portion of the airspace of the Delegating State.

6.2.6 The ATS Unit/Authority of the Contracting States may agree, however, that certain rules and procedures of the Delegating State pertaining to the provision of ATS will remain applicable in the airspace concerned.

6.3 TERMINOLOGY

6.3.1 In accordance with para. 2.1.1 of Annex 11 to the Chicago Convention the full term prescribed is delegation of "the responsibility for establishing and providing air traffic services". As this term indicates, the objective of the delegation is purely functional and will not imply any derogation of national sovereignty.

6.3.2 Thus, in the event of a State delegating to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, the term delegation of the responsibility for the provision of ATS, as provided for in the Note under para. 2.1.1 of Annex 11 to the Chicago Convention, should be used by the States (instead of delegation of airspace) when drafting their delegation agreements.

6.4 AIR TRAFFIC SERVICES

6.4.1 General

6.4.1.1 In Annex 11 to the Chicago Convention it is expressed as a Recommendation that “the delineation of airspace wherein air traffic services are to be provided, should be related to the nature of the route structure and the need for efficient service rather than to national boundaries”.

6.4.1.2 According to Note 1. under the Recommendation above it is further expressed that, “conclusions of agreements to permit the delineation of airspace lying across national boundaries is advisable when such action will facilitate the provision of air traffic services”.

6.4.2 Delegation of the responsibility for the provision of ATS

6.4.2.1 Annex 11 to the Chicago Convention (para. 2.1.1) prescribes that “contracting States shall determine, in accordance with the provisions of this Annex, and for the territories over which they have jurisdiction, those portions of the airspace and those aerodromes where air traffic services will be provided. They shall thereafter arrange for such services to be established and provided in accordance with the provisions of this Annex, except that, by mutual agreement, a State may delegate to another State the responsibility for establishing and providing air traffic services in flight information regions, control areas or control zones extending over the territories of the former”.

6.4.2.2 In the Note. under para. 2.1.1 of Annex 11 to the Chicago Convention it is expressed that, “if one State delegates to another State the responsibility for the provision of air traffic services over its territory, it does so without derogation of its national sovereignty. Similarly, the providing State’s responsibility is limited to technical and operational considerations and does not extend beyond those pertaining to the safety and expedition of aircraft using the concerned airspace”.

6.4.2.3 “Furthermore, the providing State in providing air traffic services within the territory of the delegating State will do so in accordance with the requirements of the latter which is expected to establish such facilities and services for the use of the providing State as are jointly agreed to be necessary. It is further expected that the delegating State would not withdraw or modify such facilities or services without prior consultation with the providing State. Both the delegating and providing States may terminate the agreement between them at any time”.

6.4.2.4 The States shall describe the lateral and vertical limits of the portion of airspace within which the responsibility for the provision of ATS is delegated from one State to another State.

6.4.2.4.1 In the cases where a delegation of the responsibility for the provision of ATS is based on a technically required adjustment of the AoR boundaries caused by the inability of video displays to depict the exact FIR boundaries, it may be sufficient to identify the new AoR boundary(ies) through use of significant points and agree to a broad statement that the responsibility for the provision of ATS is delegated in all airspace north, east, south or west of the AoR boundary(ies).

6.4.2.5 Both the Delegating and Providing State shall keep each other advised of any changes in the operational status of their communication and/or navigational facilities which may have an influence on the provision of ATS in the portion of airspace within which the responsibility for the provision of ATS is delegated.

6.4.2.6 Moreover, the Common Format LoA provides that both Centres shall keep each other advised of any changes in the operational status of their facilities and navigational aids which may affect the procedures specified in the Letter of Agreement (LoA).

6.4.2.7 The States shall have established procedures pertaining to revisions and cancellation of the delegation agreement. According to the **Common Format LoA**, cancellation of the LoA by either State requires that the canceling party declares its intention to cancel the LoA with a minimum pre-notification time as agreed and prescribed in the LoA. Should the Agreement on the Delegation of Air Traffic Services between the Contracting States be terminated, the LoA under it will, as a consequence, be cancelled with effect from the same date as that Agreement.

6.4.3 Authority responsible for the provision of ATS

6.4.3.1 In Annex 11 to the Chicago Convention (para. 2.1.3) it is prescribed that "when it has been determined that air traffic services will be provided, the States concerned shall designate the authority responsible for providing such services".

6.4.3.2 According to Note 1. under the paragraph mentioned above, "the authority for establishing and providing the services may be a State or a suitable Agency".

6.4.3.3 Furthermore, in the situation where a State delegates to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, "the State which designates the authority responsible for establishing and providing the air traffic services is: the State to whom responsibility for the establishment and provision of air traffic services has been delegated".

6.4.4 Scope of the delegation of the responsibility for the provision of ATS

6.4.4.1 The delegation of the responsibility for the provision of ATS should encompass air traffic control service, flight information service and alerting service.

6.4.4.2 Moreover, the delegation of the responsibility for the provision of ATS normally encompasses GAT traffic operating under IFR, unless otherwise specified.

6.4.4.3 Considering the fact that the Common Format LoA provides for, on an optional basis, the inclusion of co-ordination procedures for Operational Air Traffic and/or VFR traffic, the delegation may also include the responsibility for the provision of ATS to such Operational Air Traffic (OAT) and/or VFR traffic. Thus, in the event the Letter of Agreement encompasses co-ordination procedures for OAT and/or VFR traffic, and if the responsibility for the provision of ATS to OAT/VFR traffic is delegated, this shall be clearly specified also in the relevant paragraphs of the Letter of Agreement pertaining to delegation of the responsibility for the provision of ATS.

6.4.4.4 With respect to alerting service this is, according to ICAO definitions, "a service provided to notify appropriate organizations regarding aircraft in need of search and rescue aid, and assist such organizations as required". The responsibility for the provision of alerting service will normally fall on the ATS unit responsible for the provision of ATS in the airspace concerned.

6.4.4.5 In the event of a State delegating to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, the States should establish co-ordination procedures regarding the provision of search and rescue services for the territory connected with the airspace concerned.

6.4.4.6 According to the Common Format LoA, the Centre responsible for the provision of ATS, by virtue of delegation, shall provide alerting service and shall co-ordinate with the appropriate Rescue Co-ordination Centre as required.

6.4.5 Radar separation minima

6.4.5.1 In Annex 11 to the Chicago Convention it is prescribed that "the selection of separation minima for application within a given portion of airspace shall be as follows:

a) the separation minima shall be selected from those prescribed by the provisions of the PANS-ATM and the Regional Supplementary Procedures as applicable under the prevailing circumstances except that, where types of aids are used or circumstances prevail which are not covered by current ICAO provisions, other separation minima shall be established as necessary by:

b) the appropriate ATS authority, following consultation with operators, for routes and portions of routes contained within the sovereign airspace of a State".

6.4.5.2 As regards to the radar separation minima it is prescribed in ICAO PANS-ATM (Doc 4444) Chapter 8 that "the radar separation minimum or minima to be applied shall be prescribed by the appropriate ATS authority according to the capability of the particular radar system or sensor to accurately identify the aircraft position in relation to the centre of an RPS, PSR blip or SSR response......".

6.4.5.3 The appropriate ATS authority is, according to Annex 11 to the Chicago Convention, defined as "the relevant authority designated by the State responsible for providing air traffic services in the airspace concerned".

6.4.5.4 As a consequence, in the situation where a State delegates to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, the appropriate ATS authority designated by the Providing State should be responsible for the selection of the separation minima to be applied in the portion of airspace concerned.

6.4.6 Special activities which will have an influence on the provision of ATS

6.4.6.1 In the situation where a State delegates to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, the Providing State should be kept informed of all pertinent conditions regarding airspace restrictions (Prohibited, Restricted and Danger Areas) and airspace reservations located in the portion of airspace concerned.

6.4.6.2 Moreover, the Delegating State should keep the Providing State informed of all relevant aspects relating to the application of the EATCHIP Concept of the Flexible Use of Airspace (FUA), which will have an impact on the portion of airspace within which the responsibility for the provision of ATS has been delegated (ref. EATCHIP Airspace Management Handbook, ASM-ET1-ST08.5000-HBK-01-00).

6.4.7 SSR code assignment

6.4.7.1 In the event of a State delegating to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, the States should have established procedures for the allocation of SSR codes to the ATS units concerned.

6.4.8 Language

6.4.8.1 Regarding the language to be used it is in Volume II of Annex 10 to the Chicago Convention (para. 5.2.1.1.1) expressed as a Recommendation that "in general, the air-ground radiotelephony communications should be conducted in the language normally used by the station on the ground". Furthermore, in accordance with the Note. under the same paragraph "the language normally used by the station on the ground may not necessarily be the language of the State in which it is located".

6.4.8.2 In Volume II of Annex 10 to the Chicago Convention (para. 5.2.1.1.2) it is further expressed as a Recommendation that "pending the development and adoption of a more suitable form of speech for universal use in aeronautical radiotelephony communications, the English language should be used as such and should be available , on request from any aircraft station unable to comply with 5.2.1.1.1, at all stations on the ground serving designated airports and routes used by international air services".

6.4.8.3 The language(s) to be used in the portion of airspace within which the responsibility for the provision of ATS is delegated from one State to another State should be specified.

6.4.9 Promulgation

6.4.9.1 In Annex 15 to the Chicago Convention it is prescribed that "an aeronautical information service shall collect, collate, edit and publish aeronautical information concerning the entire territory of the State as well as areas in which the State is responsible for air traffic services outside its territory".

6.4.9.2 As a consequence, in the situation where a State delegates to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, both the Delegating and Providing State shall agree upon the content of, and publish all relevant information regarding the portion of airspace concerned, in their Aeronautical Information Package as defined in ICAO Annex 15.

6.4.10 Air Traffic Controller Licence

6.4.10.1 With regard to air traffic controller licence, Annex 1 to the Chicago Convention prescribes that "before issuing an air traffic controller licence, a Contracting State shall require the applicant to meet the requirements of 4.4.1 (see ICAO Annex 1) and the requirements of at least one of the ratings set out in 4.5 (see ICAO Annex 1). Unlicensed State employees may operate as air traffic controllers on condition that they meet the same requirements".

6.4.10.2 In Annex 1 to the Chicago Convention it is also prescribed that "a Contracting State having issued an air traffic controller licence shall not permit the holder thereof to carry out instruction in an operational environment unless such holder has received proper authorization from such Contracting State". Furthermore, "a Contracting State, having issued a licence, shall ensure that other Contracting States are enabled to be satisfied as to the validity of the licence".

6.4.10.3 In the situation where a State delegates to another State the responsibility for the provision of ATS in the airspace above its territory, the validity of the air traffic controller licences relevant to the provision of ATS in the portion of airspace concerned, should have been ensured. The training of ATS personnel of one Contracting State, providing ATS in the portion of airspace of the other Contracting State, shall include the requirements pertaining to the airspace concerned.

6.4.10.4 Furthermore, in Annex 1 to the Chicago Convention it is stated that "before exercising the privileges indicated in 4.5.3.1 (see ICAO Annex 1), the licence holder shall be familiar with all pertinent and current information".

6.4.10.5 Therefore, in the event of a State delegating to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, the Providing State should be kept advised of all pertinent and current information regarding the portion of airspace concerned, in order to accomplish properly the requirements above.

6.4.11 Forwarding of meteorological information

6.4.11.1 According to ICAO PANS-ATM (Doc 4444) Chapter 4 "air traffic services units shall forward without delay to their associated meteorological offices, in accordance with local arrangements, meteorological information received from aircraft in flight".

6.4.11.2 In the situation where a State delegates to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, the States should establish procedures regarding the forwarding of meteorological information.

6.4.12 Contingency procedures

6.4.12.1 In the event the ATS unit of the Providing State is unable to continue the provision of ATS in the portion of airspace of the Delegating State, the appropriate procedures to be applied should be specified.

6.5 APPLICATION OF THE RULES OF THE AIR

6.5.1 In Annex 2 to the Chicago Convention it is prescribed that *"the rules of the air shall apply to aircraft bearing the nationality and registration marks of a Contracting State, wherever they may be, to the extent that they do not conflict with the rules published by the State having jurisdiction over the territory overflown".*

6.5.2 As a consequence, in the portion of the airspace above the territory of a State where the responsibility for the provision of ATS is delegated to another State, the rules of the air published by the Delegating State shall apply. However, Article 12 of the Chicago Convention prescribes that "*each contracting State undertakes to keep its own regulations in these respects uniform, to the greatest possible extent, with those established from time to time under this Convention".*

6.6 TERRITORIAL MATTERS

6.6.1 (1) State Aircraft, other than those of the Delegating State, may not enter that portion of the airspace where the responsibility for the provision of ATS has been delegated without prior Diplomatic Clearance or special permission from the Delegating State.

(2) For State Aircraft operating as GAT the same rules and procedures are to be applied as for Civil Air Traffic, but where necessary, special procedures should be established to permit access to the airspace. OAT shall be subject to prior co-ordination between the military unit and the ATS Unit/Authority concerned.

6.6.2 If deemed necessary, the States should have established procedures authorizing the Delegating State to temporarily suspend or limit the delegation of the responsibility for the provision of ATS (see the Common Format LoA, para. 2.2.5).

6.7 ATS AIRSPACE CLASSIFICATION

6.7.1 In accordance with Annex 11 to the Chicago Convention "States shall select those airspace classes appropriate to their needs".

6.7.2 However, in the situation where a State delegates to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, the ATS airspace classifications as determined by the Delegating State apply in the airspace concerned.

6.7.3 Since the airspace classification is directly related to the level of ATS provided, States might, in the situation where a State delegates to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, undertake to negotiate the ATS airspace classifications to be applied in the portion of airspace concerned, in order to better accomplish the level of air traffic services requested.

6.8 AIR TRAFFIC INCIDENT INVESTIGATION

6.8.1 Regarding the applicability of Annex 13 to the Chicago Convention it is prescribed that "unless otherwise stated, the specifications in this Annex apply to activities following accidents and incidents wherever they occurred".

6.8.2 In Annex 13 to the Chicago Convention it is prescribed that "the State of Occurrence shall institute an investigation into the circumstances of the accident". Furthermore, in Annex 13 to the Chicago Convention it is expressed as a Recommendation that "the State of Occurrence should institute an investigation into the circumstances of a serious incident".

6.8.3 In Annex 13 to the Chicago Convention the terms accident, serious incident and incident are defined. In the definition of a serious incident it is noted, that the difference between an accident and a serious incident lies only in the result. A list, however not exhaustive, of serious incidents is attached to Annex 13.

6.8.4 Annex 13 to the Chicago Convention further prescribes that "any State, the facilities or services of which have been, or would normally have been, used by an aircraft prior to an accident or an incident wherever it occurred, and which has information pertinent to the investigation, shall provide such information to the State conducting the investigation".

6.8.5 Chapter 3 (Part II) of the ICAO Air Traffic Services Planning Manual (Doc 9426) is concerned with incidents specifically related to the provision of ATS and known as Air Traffic Incidents.

6.8.6 The term Air Traffic Incident is not defined, however described, according to ICAO PANS-ATM (Doc 4444), as incidents specifically related to the provision of air traffic services involving such occurrences as aircraft proximity (AIRPROX) or other serious difficulty resulting in a hazard to aircraft, caused by e.g. faulty procedures, non-compliance with procedures (PROCEDURE), or failure of ground facilities (FACILITY).

6.8.7 Air Traffic Incident Reports, intended for use by pilots and air traffic controllers, and any associated information should be recorded by the ATS unit concerned and forwarded to the appropriate investigation authority. All material relevant for the investigation should be secured.

6.8.8 The initial ATS investigation is normally carried out by the ATS unit to which the Air Traffic Incident has been reported or which noted it and should contain the following information:

statements by personnel involved;
tape transcripts of relevant radio and telephone communications;
copies of flight progress strips and other relevant data, including recorded radar data, if available;
copies of the meteorological reports and forecasts relevant to the time of the incident;
technical statements concerning the operating status of equipment, if applicable;
unit findings and recommendations for corrective actions, if appropriate.

6.8.9 In the situation where a State delegates to another State the responsibility for the provision of ATS in a portion of the airspace above its territory, it normally falls within the responsibility of the ATS unit of the Providing State to accomplish the activities described in paras. 8.7 and 8.8. The further investigation is normally carried out by the relevant investigation authorities of the Delegating State.

6.8.10 In the situation where a State delegates to another State the responsibility for the provision of ATS in a portion of the airspace above its territory the following shall apply:

1. A Contracting State will institute an inquiry into the circumstances of accidents or serious incidents occurring in its territory.

2. At its request, the Delegating State shall be provided with the necessary materials from the ATS Unit/Authority of the Providing State (e.g. radar data recordings, tape transcriptions, etc.) in order to enable it to conduct an enquiry into an accident or serious incident occurring in the Delegating State’s territory.

3. The Providing State shall be given the opportunity to appoint observers to be present at the inquiry and the Delegating State shall communicate the report and findings of the inquiry to that State.

6.9 CRITERIA FOR THE IDENTIFICATION OF AREAS WHERE DELEGATION OF ATS WOULD BE BENEFICIAL:

1) Geographical position of airports close to FIR boundaries;
2) Geographical position of major crossing points close to FIR boundaries;
3) Lateral protection of airways and/or predetermined routes close to FIR boundaries;
4) Optimising the use of available radar coverage;
5) Optimising the use of available radiotelephony coverage;
6) Optimising the use of available air traffic control capacity;
7) Rationalisation of airspace sectorisation, avoiding short sector crossing times;
8) Straightening of boundaries between ACCs to permit the transfer of control at clear operational boundaries;
9) Early transfer of control on unidirectional traffic flows;
10) On major traffic flows transfer of control where traffic is predominantly in level flight;
11) Avoiding multiple co-ordination between ACCs, where traffic penetrates one or several ACCs for short periods of time;
12) Ensuring operational continuity during climb and descent phases to avoid multiple co-ordination between ACCs;
13) Specific operations;
14) Optimising the ATS provided to reduce aircrew workload.

(Ref: Final Report of the EATCHIP Task Force on Airspace Structure and Management)

[Editorial Note: The numbering above does not indicate a ranking of priorities]

Annex 6A

MODEL AGREEMENT ON THE DELEGATION OF AIR TRAFFIC SERVICES

EUROCONTROL

The Model Agreement on the Delegation of Air Traffic Services aims at facilitating and harmonising the delegation of Air Traffic Services (ATS), and hence to contributing to the optimisation of airspace utilisation. The Model Agreement has been endorsed by the EUROCONTROL ATM/CNS Consultancy Group (ACG) and approved by the EUROCONTROL Provisional Council. Further to a decision of the ICAO European Air Navigation Planning Group (EANPG), the Model Agreement will also have been disseminated to interested parties in the whole ICAO EUR Region.

The Model Agreement addresses the legal and regulatory aspects of delegation of ATS, and allows the appropriate ATS Units/Authorities to negotiate and conclude Letters of Agreement containing the operational and technical aspects of delegation of ATS. It recognises the need for States to follow the EUROCONTROL Common Format, Cross-Border, Inter-Centre Letter of Agreement when concluding their operational Letters of Agreement (LoA).

Although this Model Agreement will have been distributed to States under separate cover, the Model Agreement is included here as background, informative material.

Text	Explanatory Notes
<u>**Preamble**</u> **A g r e e m e n t** between the Government of ......*(State)* and the Government of ......…....*(State)* ***on the Delegation of Air Traffic Services***	

The Government of ....(*State*) and the Government of..........(*State*) (hereinafter: "the Contracting States") Desiring to facilitate the safe conduct of international flight operations across their common State boundaries in the interests of the airspace users and their passengers; For the purpose of promoting air traffic services relations between the Contracting States for their mutual benefit; Being Parties to the Convention on International Civil Aviation, opened for signature at Chicago on December 7, 1944 and desiring to conclude an agreement for the purpose of providing Air Traffic Services according to the international Standards and Recommended Practices set out in Annex 11 to the Chicago Convention, across and beyond their respective territories; Referring to the ECAC Institutional Strategy for ATM in Europe and the Protocol consolidating the EUROCONTROL International Convention relating to Co-operation for the Safety of Air Navigation, which was opened for signature on 27 June 1997 (the revised Convention); Recognising that the conclusion of an agreement between States regarding the delegation of ATS shall not prejudice the principle that every State has complete and exclusive sovereignty over the airspace above its territory or the capacity of every State to exercise its prerogatives with regard to security and defence in its national airspace; Recognising, that the aim of this agreement is to address legal and institutional aspects of the delegation of ATS and to allow lower level authorities involved to negotiate and conclude Letters of Agreement containing the specific operational and technical aspects related to these matters. Have agreed as follows:	

Article 1 Definitions For the purpose of this Agreement, unless otherwise stated, the term:	
1. *"Agreement*" means this Agreement, its Appendices and any amendments thereto.	*In conformity with Annex 11 of the Chicago Convention*.
2. *"Air Traffic Service*" as a generic term includes flight information service, alerting service, air traffic advisory service, air traffic control service provided by the Contracting States.	
3. *"Appropriate ATS authority"* means the relevant authority designated by the Contracting State responsible for providing air traffic services in the airspace concerned.	
4. *"Chicago Convention"* means the Convention on International Civil Aviation, opened for signature at Chicago on December 7, 1944 and includes: a) any amendment thereof that has been ratified by both Contracting States and has entered into force under Article 94a of the Convention, and b) any Annex or any amendment thereto adopted under Article 90 of the Convention, insofar as the international Standards referred to in Article 37 of the Convention in such Annex or amendment are at any given time effective for both Contracting States.	
5. *"Delegation of ATS"* means the delegation from one State (the Delegating State) to another State (the Providing State) of the responsibility for providing air traffic services in a portion of airspace extending over the territories of the former.	
6. *"GAT" or General Air Traffic* means flights conducted in accordance with the rules and provisions of ICAO.	
7. *"OAT" or Operational Air Traffic* means flights which do not comply with the provisions stated for GAT and for which rules and procedures have been specified by the appropriate authorities. 8. *"Territory" in* relation to a State, has the meaning specified in Article 2 of the Chicago Convention.	*Article 2 of the Chicago Convention:* "Territory: For the purposes of this Convention the territory of a State shall be deemed to be the land areas and the territorial waters adjacent thereto under the sovereignty, suzerainty, protection or mandate of such State."

Article 2 Authorisation to Lower Level Authorities (ATS Unit /ATS Authority) (1) The Contracting States agree that the responsibility for control of air traffic shall be transferred from an ATS unit of one State to another ATS unit in a neighbouring State, according to the provisions set forth in Annex 11 and under the terms of this Agreement. (2) The control information pertinent to the transfer shall be exchanged between the ATS units concerned having due regard to the national regulations in force and to the local circumstances. (3) The Contracting States agree that the appropriate ATS Unit/Authority of one State may provide air traffic services in a portion of the airspace of the other State, in accordance with the terms of this Agreement. (4) To that effect the Contracting States authorise their appropriate ATS Units/Authorities to conclude Letters of Agreement (LoA). (5) These Letters of Agreement (LoA) shall define the portion of airspace concerned and specify the rules and procedures to be applied in accordance with the provisions of this Agreement and shall follow the structure of the EUROCONTROL Common Format, Cross-Border, Inter-Centre Letter of Agreement (Hereinafter the *Common Format LoA*).	*Based on the provisions of Annex 11 of the Chicago Convention and the conclusions of MATSE/5.* *Paragraph 4 refers solely to paragraph 3 of Article 2. Hence the words "To that effect".* *The present Common Format LoA of EUROCONTROL will serve as a guideline for States.*

Article 3 Application of Rules and Procedures (1) The rules and procedures pertaining to the provision of ATS in the Providing State shall apply when providing ATS in a portion of the airspace of the Delegating State. (2) The ATS Unit/Authority of the Contracting States may agree, however, that certain rules and procedures of the Delegating State pertaining to the provision of ATS will remain applicable in the airspace concerned.	*As a principle of sovereignty, the rules and procedures of the Delegating State apply in its territory. It is, however, actual practice to apply the rules and procedures pertaining to the provision of ATS of the Providing State. In the interest of safety and for the sake of efficiency, it is necessary that the air traffic controller is able to apply only one set of rules and procedures – those of the Providing State.*
Article 4 Financial Arrangements (1) Each Contracting State shall bear the costs of any activity performed by it under this Agreement, unless otherwise agreed by the Contracting States. (2) The introduction of financial arrangements requires prior written agreement between the appropriate representatives of the Contracting States.	*Generally, the delegation of ATS is in the interest of the service provider. The reason for delegation of ATS is in many cases lack of airspace to provide a proper service to the users.* *Activities involving inter alia cost-sharing or revenue sharing are subject to bilateral negotiations. Reasons for doing it could be manifold.*

Article 5 Civil Liability (1) The Providing State shall be liable for the damage caused by its negligence, or that of its agents or of any other person acting on its behalf, under the provisions of this Agreement. (2) Claims against the Providing State, its agents or any other person acting on its behalf shall be made in the courts, and subject to the law of the Providing State. (3) The Delegating State may bring an action against the Providing State to recover any compensation or costs paid or incurred as a result of loss or damage caused by the negligence of the Providing State, its agents or any other person acting on its behalf, while applying the provisions of this Agreement. The action shall be brought in the courts, and subject to the law of the Providing State.	*Provisions of this article are only applicable in the relationship between the Contracting States and do not constitute rights or obligations for third parties.*
Article 6 Licensing and Training (1) The Contracting States agree that: (a) an air traffic controller licence issued by one Contracting State, or (b) an authorisation by a service provider, or (c) an authorisation to a unlicensed State employee to operate as an air traffic controller, is valid for the provision of air traffic services in the portion of the airspace of the other Contracting State within which the responsibility for the provision of ATS is delegated. (2) Training of ATS personnel of one Contracting State, providing ATS in the portion of airspace of the other Contracting State, shall include the requirements pertaining to the airspace concerned.	*This is actual practice which is applied by several ATS Units/Authorities in the world.* *Different airspace classifications, restricted and reserved areas and/or special regulations in the neighbouring State including military procedures should be taken into account.*

<u>Article 7</u> State Aircraft (1) State Aircraft other than those of the Delegating State may not enter that portion of airspace where the responsibility for the provision of ATS has been delegated without prior Diplomatic Clearance or special permission from the Delegating State. (2) For State aircraft operating as **GAT** the same rules and procedures are to be applied as for Civil Air Traffic, but where necessary, special procedures should be established to permit their access to the airspace. **OAT** shall be subject to prior co-ordination between the military unit and the ATS Unit/Authority concerned.	*Generally a distinction between GAT and OAT is made to reflect their different objectives. For GAT, the relevant ICAO regulations (transferred into national law) would be applicable.*
<u>Article 8</u> Co-ordination and Contingency Procedures for Military and Other Reasons (1) Letters of Agreement (LoA) shall be supplemented by co-ordination and contingency procedures established by the Units/Authorities concerned. (2) The ATS Unit/Authority of the Providing State shall provide the appropriate military Authorities/Units of the Delegating State with pertinent flight plans and other data concerning the flights in the airspace where the responsibility for the provision of ATS has been delegated.	*The co-ordination and contingency procedures could include the following item, in accordance with Annex 11 and 2 of the Chicago Convention:* *service the aircraft in the event of an emergency* *steps to be taken in-flight contingencies* *steps to be taken to assist the strayed aircraft* *steps to be taken concerning the interception of (civil) aircraft / unlawful use of the airspace* *co-ordination between military authorities and air traffic services* *co-ordination of activities potentially hazardous to civil aircraft* *information exchange between the appropriate civil and military authorities / units* *requirements relating to the diplomatic clearances or for special permissions for State Aircraft of the other State*

<u>Article 9</u> Publication Contracting States shall agree upon the content of, and publish all relevant information regarding the portion of airspace, where the responsibility for the provision of ATS has been delegated, in their Aeronautical Information Package as defined in Annex 15 to the Chicago Convention.	
<u>Article 10</u> Investigation of Accidents or Serious Incidents (1) A Contracting State will institute an inquiry into the circumstances of accidents or serious incidents occurring in its territory. (2) At its request, the Delegating State shall be provided with the necessary materials from the ATS Unit/Authority of the Providing State (e.g. radar data recordings, tape transcriptions, etc.) in order to enable it to conduct an inquiry into an accident or serious incident occurring in the Delegating State's territory. (3) The Providing State shall be given the opportunity to appoint observers to be present at the inquiry and the Delegating State shall communicate the report and findings of the inquiry to that State.	***In conformity with Article 26 and Annex 13 of the Chicago Convention.*** *In conformity with Directive 94/56 of the European Council.* *Co-ordination between the two States concerned is in most cases necessary.*

Article 11 Dispute Resolution (1) If any dispute arises between the Contracting States regarding the interpretation or application of any provision of this Agreement, the Contracting States shall in the first place endeavour to settle it by negotiation. (2) If the Contracting States are unable to resolve any disagreement by negotiation, the dispute shall be submitted for final decision to a third party (arbitrator) designated by both Contracting States. (3) The costs of arbitration, including its fees and expenses, shall be shared equally by the Contracting States.	*The possibility that the Contracting States could elect EUROCONTROL as their arbitrator was suggested by the members involved in the drafting of this Agreement.*
Article 12 Termination/Suspension (1) This Agreement may be terminated by either Contracting State at any time by written notice to the other Contracting State. The termination shall become effective {12} months after the date of receipt of such notice by the other Contracting State. (2) In the event of war, during a period of emergency or in the interest of public safety, or in other exceptional circumstances, each Contracting State has the right to suspend or terminate the Agreement with immediate effect, and shall notify the other Contracting State accordingly. (3) The Letters of Agreement referred to in Article 2 (5) shall contain provisions regarding their suspension and termination.	*See Article 9 of the Chicago Convention.* *This is to meet defence requirements. If this agreement (State level) is terminated, the LoA under it will, as a consequence, be cancelled with effect from the same date of termination.*

<u>Article 13</u> Entry into Force (1) This Agreement shall enter into force as soon as the Contracting States have notified each other in writing of the completion of their respective constitutional requirements. (2) This Agreement may be provisionally applied from the date of its signature.	
<u>Article 14</u> Amendments (1) If a Contracting State considers it desirable to amend any provisions of this Agreement, it may request consultations with the other Contracting State. Any amendments agreed by the Contracting States shall come into force when they have been confirmed by an exchange of diplomatic notes. (2) Amendments to the Attached *Common Format LoA* may be jointly determined by direct Agreement between the appropriate ATS Units/Authorities of the Contracting States.	
<u>Article 15</u> Transitional Measures for Agreements Already in Operation Agreements which are in operation on the date of entry into force of this Agreement shall be assessed for possible revision in accordance with the provisions set out in this Agreement.	*"Agreements already in operation" refers to agreements on co-ordination procedures as well as agreements at the State level.*
<u>Article 16</u> ICAO Registration This Agreement shall be registered with the ICAO Council, in accordance with the provisions of Article 83 of the Chicago Convention.	

In witness whereof, the undersigned, being duly authorised by their respective Governments, have signed this Agreement. Done in duplicate at.............................. this..........day of 2000 in the English ( ) languages. In case of any divergence of interpretation of the text, the English one shall prevail. For the Government of For the Government of	

SECTION 6

GUIDELINES
FOR DELEGATION OF THE RESPONSIBILITY
FOR THE PROVISION OF ATS

FINAL PAGE

SUGGESTION - COMMENTS

To propose modifications, if so required, to the present Section 6 "Guidelines for Delegation of Air Traffic Services", please contact:

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Airspace Management & Navigation Unit (AMN)
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SECTION 6 - SPONSOR: ATM PROCEDURES DEVELOPMENT SUB-GROUP

Whenever material received, in accordance with the above procedure, makes it apparent that an amendment of the present Section 6 is required, such amendment will be first discussed within the ATM Procedures Development Sub-Group (APDSG) before its adoption by the Airspace & Navigation Team (ANT).

PUBLICATION OF AMENDMENT

The agreed amendment will then be issued by EUROCONTROL in the form most convenient for its insertion in the Planning Manual.

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SECTION 7

GUIDELINES FOR FREE ROUTE AIRSPACE DESIGN

7.1 INTRODUCTION

7.1.1 TBD

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SECTION 8

TERMS AND REFERENCES

8.1 ACRONYMS AND ABBREVIATIONS

ACA	AUP/UUP Composition Application
ACAS	Airborne Collision Avoidance System
ACC	Area Control Centre
ACFT	Aircraft
AD	Air Defence
ADG	Aerodrome Control (Tower)
ADS-B	Automatic Dependent Surveillance – Broadcast
AGL	Above Ground Level
AIP	Aeronautical Information Publication
AIRSAW	Airborne Situational Awareness
AIS	Aeronautical Information Service
AMAN	Arrival Manager
AMC	Airspace Management Cell
AME	ATM Message Exchange
AMHS	Aeronautical Message Handling Service
AMN	EUROCONTROL Airspace Management & Navigation Unit
AMSL	Above Mean Sea Level
ANT	EATMP Airspace & Navigation Team
AO	Aircraft Operator
AOM	Airspace Organisation & Management (one of EATMP Programmes)
AOWIR	Aircraft Operator What-if Re-routing (CFMU Function)
APATSI	Airports/Air Traffic Services Interface
APD-SG	ATM Procedures Development Sub-Group of ANT
APP	Approach (Control)
APW	Airspace Penetration Warning
ARN	ATS Route Network
ARO	ATS Reporting Office
ASAS	Airborne Separation Assurance System
ASM	Airspace Management
ASM-SG	Airspace Management Sub-Group of ANT
ATC	Air Traffic Control
ATCC	Air Traffic Control Centre
ATCO	Air Traffic Control Officer
ATCU	Air Traffic Control Unit
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management (ATS+ASM+ATFM)
ATN	Aeronautical Telecommunications Network
ATS	Air Traffic Services
ATSU	Air Traffic Service Unit
ATZ	Aerodrome Traffic Zone
AUP	Airspace Use Plan
AW	Aerial Work
B-RNAV	Basic Area Navigation

CAA	Civil Aviation Authority
CADF	ECAC Centralised Airspace Data Function
CBA	Cross-Border Area
CDR	Conditional Route
CDM	Collaborative Decision-Making
CDTI	Cockpit Display of Traffic Information
CFMU	EUROCONTROL Central Flow Management Unit
CIP	Convergence and Implementation Plan
CNS	Communication, Navigation and Surveillance
CODA	Central Office for Delay Analysis (EUROCONTROL)
COM	Communication
COTRAC	Common Trajectory Co-ordination
CPDLC	Controller-Pilot Data Link Communications
CPL	Current Flight Plan
CRAM	Conditional Route Availability Message
CRCO	Central Route Charges Office (EUROCONTROL)
CRDA	Converging Runway Display
CTA	Control Area
CTR	Control Zone
CVFR	Controlled VFR
D	Danger Area
DAA	Dynamic Airspace Allocation
DAP	Down-linked Aircraft Parameter
D-FIS	Data link Flight Information Services
DMAN	Departure Manager
DME	Distance Measuring System
DSC	Downstream Clearance (data link)
DYNAV	Dynamic Route Availability Service (data link)
EAD	European AIS Database
EANPG	ICAO Regional European Air Navigation Planning Group
EATCHIP	European ATC Harmonisation and Integration Programme
EATMP	European Air Traffic Management Programme
EATMS	European Air Traffic Management System
EC	European Commission
ECAC	European Civil Aviation Conference
ECIP	European Convergence and Implementation Plan
eFDP	European Flight Data Processing (Programme)
ETFMS	Enhanced Tactical Flow Management System
EUR ANP	ICAO European Air Navigation Plan
EUROCAE	European Organisation for Civil Aviation Electronics
EUROCONTROL	European Organisation for the Safety of Air Navigation
FDPS	Flight Data Processing System
FIR	Flight Information Region
FIS	Flight Information Service
FFA	Free Flight Airspace
FFAS	Free Flight Airspace Regime
FL	Flight Level
FLIPCY	Flight Plan Consistency
FMP	Flow Management Position

FMS	Flight Management System
FPL	Filed Flight Plan
FRA	Free Route Airspace
FRAP	Free Route Airspace Project
Ft	feet
FUA	Flexible Use of Airspace
GA	General Aviation
GAT	General Air Traffic
GND	Ground (Level)
GPS	Global Positioning System
HBK	ASM Handbook
IATA	International Air Transport Association
IACA	International Air Carriers Association
IAOPA	International Council of Aircraft Owner and Pilot Associations
ICAO	International Civil Aviation Organisation
IFATCA	International Federation of Air Traffic Controllers' Associations
IFPS	Integrated Initial Flight Plan Processing System
IFR	Instrument Flight Rules
IM	Information Management
IMC	Instrument Meteorological Conditions
JAA	Joint Aviation Authorities
K	Know Traffic Environment
(k)m	(kilo)metres
LCIP	Local Convergence and Implementation Plan
LoA	Letter of Agreement
MASPS	Minimum Aircraft System Performance Specification (ICAO)
MOD	Ministry of Defence
Mode S	Selective Co-operation Secondary Surveillance System
MOPS	Minimum Operational Performance Standards (Specifications) / FAA
MOT	Ministry of Transport
MSAW	Minimum Safe Altitude Warning
MSSR	Mono pulse Secondary Surveillance Radar
MTCD	Medium Term Conflict Detection
N	Intended Traffic Environment
NATO	North Atlantic Treaty Organisation
NAV	Navigation
NBD	Non-Directional Beacon
NM	Nautical Miles
NOTAM	Notice to Airmen
NSG	Navigation Sub-Group of ANT

OAT	Operational Air Traffic
OCD	Operational Concept Document
OLDI	On-Line Data Interchange
P	Prohibited Area
PIB	Pre-flight Information Bulletin
PMP	Programme/Project Management Plan
PPD	Pilot Preferences Downlink (data link)
P-RNAV	Precision Area Navigation
PSR	Primary Surveillance Radar
R	Restricted Area
RAP	Recognised Air Picture
RCA	Reduced Co-ordination Airspace
RDPS	Radar Data Processing System
RIA	Regulatory Impact Assessment
RNAV	Area Navigation
RND-SG	Route Network Development Sub-Group of ANT
RNP	Required Navigation Performance
RPV	Remotely Piloted Vehicle
RTF	Radio Telephony Frequency
RVSM	Reduced Vertical Separation Minimum
RWY	Runway
R&D	Research and Development
SA	Separation Assurance
SARPS	Standards and Recommended Practices (ICAO)
SID	Standard Instrument Departure (Route)
SLoA	Stakeholder Line of Action (ECIP, LCIP)
SRA	Special Rules Area
SRS	Standard Routeing Scheme
SRZ	Special Rules Zone
SSR	Secondary Surveillance Radar
STAR	Standard (Instrument) Arrival Route
STCA	Short Term Conflict Area
SUR	Surveillance
SWIM	System-Wide Information Management
TACT	CFMU Tactical System
TIA	Traffic Information Area
TIZ	Traffic Information Zone
TMA	Terminal Control Area
TPIAS	Transition Plan for the Implementation of the Airspace Strategy
TRA	Temporary Reserved Airspace
TSA	Temporary Segregated Area
TWR	Tower

U	Unknown Traffic Environment
UAC	Upper Area Control Centre
UAV	Uninhabited Aerial Vehicle
UCAS	Uncontrolled Airspace
UHF	Ultra High Frequency (300 to 3000Mhz)
UIFR	Uncontrolled IFR
UIR	Upper Information Region
UMAS	Unmanaged Airspace
UN	United Nations
UTA	Upper Control Area
UTC	Co-ordinated Universal Time
UUP	Updated Airspace Use Plan
VFR	Visual Flight Rules
VHF	Very High Frequency (30 to 300Mhz)
VMC	Visual Meteorological Conditions
VOR	VHF (Very High Frequency) Omni-Range
WEU	Western European Union
WGS	World Geodetic Survey

8.2 EXPLANATION OF TERMS

TBD

8.3 REFERENCES AND SOURCE DOCUMENTS

TBD

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