GOVERNMENT AND INDUSTRY GUIDELINES AND CONCEPTS FOR NAS ANALYSIS AND REDESIGN

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Foreword

This document was prepared by Special Committee 192 (SC-192) and approved by the RTCA Program Management Committee (PMC) on June 8, 1998.

RTCA, Incorporated is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization functions as a Federal Advisory Committee and develops consensus based recommendations on contemporary aviation issues. RTCA's objectives include but are not limited to:

- Coalescing aviation system user and provider technical requirements in a manner that helps government and industry meet their mutual objectives and responsibilities;

- Analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;

- Developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and

- Assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunication Union and other appropriate international organizations can be based.

The organization's recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders.

Since RTCA is not an official agency of the United States Government, its recommendations may not be regarded as statements of official government policy unless so enunciated by the U.S. government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

Executive Summary

Background

The Air Traffic Services organization of the Federal Aviation Administration (FAA) is conducting a review of the airspace resources in the National Airspace System. The objectives of this review include developing a cohesive plan for managing airspace changes, establishing and directing a financial plan to meet airspace priorities, establishing standards for modeling and analysis, and developing strategies for environmental assessment of airspace changes. Representation from the user community and industry is critical in completing these challenging objectives.

At the request of Air Traffic, RTCA established Special Committee 192, National Airspace Review Planning and Analysis, in March 1997. This special committee is chartered to provide guidance and recommendations to the FAA for the review and management of national airspace redesign. These recommendations will ensure that the resulting airspace restructuring support increased safety and efficiency in the NAS. This committee represents the views and perspectives of all airspace users and stakeholders, and will address issues associated with all types of domestic and oceanic airspace.

Summary of Committee Results

This document contains two volumes and represents the products of the work groups of Special Committee 192: National Airspace Review Planning and Analysis. Volume I, entitled *A Concept Document for the Optimization of the NAS Airspace Structure*, presents concepts for a national airspace assessment and redesign that addresses significant changes to matters pertaining to the national airspace by the year 2005. Concepts in Volume I do not describe an end-state system, but define initial changes and interim amendments in the air traffic environment, and lay the groundwork for transitional phases prior to the year 2005. Volume II, entitled *Guidelines for Conducting Airspace Analysis*, contains the general guidelines for airspace analysis, including metrics, modeling, and data requirements. These guidelines are both high-level and broadly applicable, and designed to be specifically useful in formatting and conducting most airspace analyses.

Volume I Summary

The primary product of the Design and Infrastructure Work Group is encompassed in Volume I. This material parallels the government and industry supported future operational concepts for Free Flight. The guidelines and considerations outlined in Volume I represent an opportunity to make fundamental changes to the basic structure of current, interim and the future NAS. The concepts in Volume I lay the groundwork for transitional phases prior to the year 2005. The key elements of the concept include:

- High-level, overarching, context-setting policy, assumptions, and principles
- Airspace Design Concepts: Vertical and horizontal dimensions to enhance user access to services for the terminal, en route, oceanic domains
- Sectorization Design Concepts: Including regional sectors and dynamic/adaptive sectors
- Infrastructure: Discussion of enabling ATM/CNS capabilities and procedural enhancements, such as decision support systems, ground and cockpit capabilities, and management concepts.

Volume II Summary

The primary product of the Models and Measurement Work Group is encompassed in Volume II. Volume II provides guidelines in a number of areas including high level descriptions of how to plan, structure, and conduct an overall airspace study. More detailed guidelines on how to structure and carry out specific modeling and analysis steps of an airspace study are also described. Volume II also specifies considerations in selecting metrics, models, and data used in analyzing airspace. The appendices of Volume II summarizes many of the existing models that are most relevant to airspace analyses.

Overarching Recommendations

While specific recommendations are included as part of both volumes, there are four overarching recommendations that encompass elements of both volumes that are presented here. As the FAA's National Airspace Redesign has just recently been launched, the first recommendation from Special Committee 192 involves the continuation of the government/industry collaborative oversight that has provided initial input to the FAA's efforts. Special Committee 192 recommends that:

- Within three months of receiving this report, the FAA should reinforce the charter of Special Committee 192 with the following objectives:
  - Periodic review of government/industry progress in implementation of the recommendations and guidelines put forth in this document,
  - Identification of opportunities for implementing and applying the recommendations and guidelines in the FAA's National Airspace Redesign activities,
  - Identification of events/situations that are inhibiting progress to implementation of the concept and guidelines of this document, and make recommendations on actions that should be taken, and review those subsequent actions as they are taken.

Three additional recommendations focusing on general guidance to the FAA's National Airspace Redesign were presented at the January 1998 plenary session of Special Committee 192:

- Airspace and sector design should include planning for future concepts, such as Free Flight. These design activities should be consistent with the Free Flight concept and implementation phases. Emphasis should be placed on minimizing structure and maximizing user flexibility and access. Where structure is needed to maintain safety, user preferences should be maximized. Free Flight operations can be expected to be initiated in the higher flight levels where there is less climbing and descending activity and the horizontal flexibility of user preferred routes is possible. The airspace design review should focus on those high altitude areas to facilitate Free Flight. Airspace planning should also prepare for Free Flight expansion to lower flight levels and altitudes where more trajectory flexibility and aircraft separation from the cockpit will be implemented.
- As part of the national-level effort to redesign airspace, a focused activity should be launched to identify and determine the constraints that will impact the design of airspace and sector design and concepts. These constraints may include human factors issues such as complexity, training, dynamic density, workload; and, architectural and infrastructure limitations such as what capabilities are needed and available in given timeframes.

- The reciprocal relationship between architecture/infrastructure capabilities and the airspace/sector design should be proactively addressed. The enabling connectivity between airspace/sector design and architecture components should be understood as part of programmatic and investment decisions.

Acknowledgments

The Modeling and Measurement Working Group of RTCA Special Committee 192 wishes to acknowledge the use of *Final Report on Existing and Required Modeling Capabilities for Evaluating ATM Systems and Capabilities* completed for the NASA Ames Research Center by the International Center for Air Transportation of the Massachusetts Institute of Technology. Selected reviews of the most relevant airspace-related models were extracted from this document and were revised and updated where necessary based on information from other sources. The revised reviews were combined with information on other relevant models to form the synopses and detailed reviews contained in Appendix B.

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1.0 INTRODUCTION

This document describes a concept for a national airspace design review that addresses significant changes to matters pertaining to the National Airspace System (NAS) by the year 2005. The aviation community has recognized the need to move from the current ground-based infrastructure to one that utilizes state-of-the-art communications, navigation, and surveillance systems. This document encourages the continued migration of the NAS from a ground-based infrastructure to one that encompasses both ground and airborne systems.

1.1 Background

It has been many years since there was a comprehensive review of the design and structure of the airspace. The National Airspace System Plan of 1982 required a National Airspace Review as detailed in the Federal Register of April 22, 1982. This was the original look at airspace to standardize and simplify, and to incorporate International Civil Aviation Organization (ICAO) standards. The National Airspace Review resulted in the new classifications of airspace A, B, C, D, E, and G that was implemented in 1993.

The Federal Aviation Administration's (FAA) Air Traffic Airspace Management Program (ATA) was established in April 1996 to provide management oversight of all ongoing and future airspace plans that would affect airspace efficiency. Recognizing that user involvement in this process was needed, the FAA asked for RTCA assistance. At the request of the FAA, RTCA established RTCA Special Committee 192, National Airspace Review.

Planning and Analysis, to provide guidance, direction, and recommendations to the FAA's review and management of the national airspace. The objectives of the FAA's national airspace design review include developing a cohesive plan for managing airspace changes, establishing and directing a financial plan to meet airspace priorities, establishing standards for modeling and analysis, and developing strategies for environmental assessment of airspace changes.

RTCA Special Committee 192 will provide the FAA with recommendations on how to effectively monitor, direct, plan, analyze, and manage the airspace structure within the NAS. This working group recognizes that the FAA is presently engaged in a NAS modernization program to take advantage of new technologies to accommodate concepts such as free flight.

The Design and Infrastructure Working Group of RTCA Special Committee 192 has the primary concern of optimization of the NAS airspace structure. This optimization is to be accomplished through meeting airspace design requirements with an incremental approach in order to achieve the earliest possible benefits. Additionally, the working group actively supports working towards interim and long range airspace designs to meet future needs. To meet the emerging user needs for greater flexibility in planning

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and conducting flight operations, the air traffic system must evolve in the areas of airspace, procedures, roles and responsibilities, equipment and automation.

1.2 Scope and Intended Use of This Document

This document parallels the *Government/Industry Operational Concept for the Evolution of Free Flight* [1] and the *NAS Operations Concept for 2005* [2]. It represents an opportunity to make fundamental changes to the basic structure of current, interim and the future NAS. Concepts in this document do not describe an end-state system, but define initial changes and interim amendments in the air traffic environment, and lays the groundwork for transitional phases prior to the year 2005.

This document is subject to ongoing evaluation and validation and will be modified to reflect the results of maturing concepts related to development and implementation of air traffic services and operational capabilities within the NAS. These concepts will be used to coordinate and define FAA policies and will be updated to reflect changes in strategy.

RTCA Special Committee 192 will complete their initial report by June 1998. The challenge is to make recommendations that are technically feasible, affordable, and operationally sound. In the near-term, the focus will be on actions that increase the users' flexibility in the operation of their aircraft. This will be achieved by concentrating on removing constraints and restrictions to flight planning, scheduling and flight operations, better exchange of information, collaborative decision making among users and service providers, more efficient management of airspace and airport resources, and tools and models to aid airspace service providers.

This working group has focused on a review of the NAS and the more efficient management of airspace. This focus is consistent with the incremental approach to free flight, and balances the needs of the aviation community with the expected resources of both the FAA and the users. The transition to free flight will occur gradually, as a function of available technologies, procedural changes, different requirements within the aviation community and the need for greater capacity in the airspace system.

1.3 Objectives

In developing this concept document, RTCA Special Committee 192 is committed to meeting the following objectives.

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Safety:	To maintain or increase, under varying conditions, the level of safety, making full use of available information and technologies.
Efficiency:	To fully exploit the existing capacity of the NAS and to continually improve capacity to meet current and future demands of the users, enabling timely introduction of new functionality.
Cost Effectiveness:	To provide services consistent with needs for a balanced, fair, and economically justified system.
User/Provider Preferences:	To allow for optimum flight profiles and trajectories, as well as special user needs such as military operations. This concept must meet the civilian/military coordination and integration requirements.
Adaptability:	To be able to respond to unexpected user demands, and to future user demands, as well as to evolving operational requirements established by the service provider.
Contingency Requirements:	To define and prepare measures that ensure air traffic services can be continued in the event of a complete service outage and/or malfunctions, and to provide ample time and scope to solve problems that have occurred.
National Security Requirements:	To accommodate national security requirements, particularly in terms of Department of Defense needs.

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