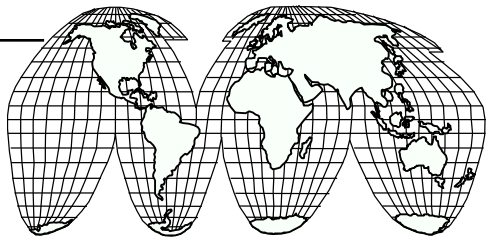
RTCA

Government/Industry Operational Concept for the Evolution of Free Flight

Addendum 3.1:
SURVEILLANCE
Roadmap for Surveillance Modernization

Approved by the RTCA Free Flight Steering Committee
August 16, 2000



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Foreword

This report was approved the RTCA Free Flight Steering Committee on August 16, 2000.

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.

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Executive Summary

This roadmap presents a consensus for the evolutionary modernization of surveillance capabilities in the National Airspace System (NAS). This roadmap is based on the operational objectives identified in the RTCA document, *Addendum 3: Surveillance, Government/Industry Operational Concept for the Evolution of Free Flight.* Both documents are driven by the ubiquitous need to improve aviation safety, capacity and efficiency. While many near term improvements are defined, the transition period for fully implementing new technologies will extend to the year 2020.

The modernized surveillance system must combine new operational procedures, improved automation and decision support tools, and new sensor technologies for both air and ground users to achieve the needed benefits. This must be accomplished within FAA budget constraints, and with aircraft systems that are affordable to all users.

This roadmap transforms the Concept of Operation into a set of target architecture characteristics. Fundamental characteristics of the desired target state include delivery of a common surveillance "picture" to ATC service providers, flight crews, and airport/airline operational personnel, the utilization of "enriched" surveillance data for decision support tools, and reliance on ADS-B as the "cornerstone" of the future surveillance architecture. Key characteristics of the target architecture and the evolutionary steps include the following:

- Use of cooperative surveillance will become the system's cornerstone, where cooperative surveillance is defined as a method of surveillance requiring participating aircraft to carry some form of cooperating electronic equipment. With cooperative surveillance, the system depends to some extent on data supplied/derived via positive exchange of surveillance data.
- NAS Surveillance is based on dual independent surveillance coverage; e.g., today it is Primary & SSR.
  - Protects against operational capability failures under single failure events
  - Retains operational fall back to procedural airspace under multiple failure conditions
- Surveillance is performance-based, in harmony with the Performance-based NAS.
  - Supports Required Surveillance Performance (RSP) based operations, procedures and automation.
- Consistent, relevant information is distributed to all users
  - Decision support tools and automation uses new and expanded information.
- The architecture provides cost-effective, performance-based surveillance NAS
  - Provides greatly expanded surveillance coverage
  - Information exchange coverage couples airborne capabilities and new operational concepts

This document also identifies key business case considerations and activities that will appropriately justify both FAA and industry investment commitments. Addressing these considerations is critical to validating the envisioned architecture and anticipated operational benefits.

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Key Findings and Recommendations

The development of the Surveillance Roadmap led to significant findings regarding the current and future NAS. The key recommendations developed to take first steps in achieving surveillance benefits are in the following areas:

- To support desired operations, implementation of common coordinate system and enhanced, common surveillance data format is needed, along with data sharing and multi-sensor integration
- Evolution to use of RSP as the basis for defining airspace surveillance requirements
- Validation steps are recommended to develop a business case that addresses the evolution of the surveillance architecture to the target vision and to develop new procedures (SF21 and follow-on)
- Validation is also needed to assess the value of improved surveillance in decision support tools and automation
- Widespread user commitment risk related to role of ADS-B for collision avoidance and its implications should be addressed

Conclusions

This roadmap and the associated *Addendum 3: Surveillance, Government/Industry Operational Concept for the Evolution of Free Flight* present a consensus foundation for a plan for the evolutionary modernization of surveillance capabilities in the National Airspace System. It recognizes the need for changes at all levels and phases of the NAS surveillance capabilities. As the business case is developed and benefits are validated, this vision will be refined to reflect new insights into the value and role of enhanced surveillance.

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1.0 Introduction

This document provides a roadmap for the modernization of surveillance capabilities in the National Airspace System (NAS). It is part of an overall government/industry activity to assess the evolution of surveillance services and of the surveillance architecture. This roadmap is based on the operational objectives identified in the RTCA document, *Addendum 3: Surveillance, Government/Industry Operational Concept for the Evolution of Free Flight* [1], hereinafter referred to as the "Surveillance Ops Concept". The goals for surveillance modernization are driven by the need to meet the increasing demand for NAS resources and to continue to enhance the high-level of safety achieved in the NAS. Capabilities to address this need that build on improved surveillance were used to derive key surveillance capabilities needed and the underlying architecture functional elements.

As defined in the *Surveillance Ops Concept* [1], **surveillance** is defined as the detection, tracking, characterization, and observation of aircraft, other vehicles, and weather phenomena for the purpose of conducting flight operations in a safe and efficient manner. The primary purposes of surveillance are to control the flow of aircraft, provide situation awareness for pilots and controllers, and separate aircraft. Methods of surveillance include voice reports, visual acquisition, radar (both primary and secondary), and other new technologies such as automatic dependent surveillance. Surveillance information (including position, velocity vector, identification, and intent) can be used either in a ground facility or in the cockpit. In addition, surveillance may be used to support functions such as fleet monitoring and management, traffic flow management, and search and rescue operations. The quality of aircraft surveillance can be described in terms such as the target update rate, position accuracy, velocity vector accuracy, integrity, reliability, and availability.

This document focuses on the surveillance capability and architecture needed to achieve the operational concept. Along the way, evaluation of procedures, technologies, Human Machine Interface (HMI) advances, and domestic and international policies will shape the final outcome. In addition, there are other efforts currently underway in international fora to promote a global airspace, which provides increased capacity, efficiency, cost effectiveness, and safety.

1.1 Purpose

This document represents a consensus vision for a target surveillance architecture that evolves from the current NAS surveillance infrastructure over the next two decades. More importantly, this document also identifies key decision points and needed validation and business case activities that will enable both FAA and industry commitments for surveillance investments.

1.2 Scope

Two key concepts are applied to surveillance modernization. First, NAS surveillance evolves from radar-based operations to an information-based set of operations. In this context, information-based means that NAS operations are based on the quality of surveillance information available, rather than being tied to the characteristics of a

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specific radar system. Second, surveillance enhancements are only effective when they are implemented in an end-to-end manner. This involves integration of surveillance technologies, information processing, distribution, use by decision support tools, procedures, and display of information.

This document addresses the evolution of surveillance capabilities from the present to approximately 2020. This timeframe is needed to accommodate NAS surveillance systems life cycles as well as the fleet upgrade cycles of the user community.

The focus of this document is an integrated surveillance environment. One of the key elements of the surveillance evolution, Automatic Dependence Surveillance Broadcast (ADS-B), is expected to play an increasing role in the NAS as capabilities evolve, and is expected to be a key element in delivering the desired operational improvements identified in the Surveillance Ops Concept. As defined in RTCA DO-242, the Minimum Aviation System Performance Standards for Automatic Dependent Surveillance Broadcast (ADS-B) [2]:

> **ADS-B** is a function on an aircraft or a surface vehicle operating within the surface movement area that periodically broadcasts its state vector (horizontal and vertical position, horizontal and vertical velocity) and other information. ADS-B is automatic because no external stimulus is required to elicit a transmission; it is dependent because it relies on on-board navigation sources and on-board broadcast transmission systems to provide surveillance information to other users. The aircraft or vehicle originating the broadcast may or may not have knowledge of which users are receiving its broadcast; any user, either aircraft or ground-based, within range of this broadcast, may choose to receive and process ADS-B surveillance information.

ADS-B has the potential to support improved use of airspace, reduced ceiling/visibility restrictions, improved surface surveillance, and enhanced safety such as conflict management. Initially, ADS-B will be used for cockpit-based operations. As experience is gained, it will also be used for aircraft-to-ground surveillance reporting, and ADS-B data will be integrated into the surveillance information database.

1.3 Document Organization

The remainder of this document contains the following four sections:

- Section 2 provides a description of the key mission needs and their relationship to surveillance, capabilities to satisfy those needs, and the resulting proposed target architecture.
- Section 3 presents an overview of the evolution steps and business case considerations associated with those steps.
- Section 4 is an integrated set of findings and recommendations.
- Section 5 contains a summary.

In addition to the main parts of this document, several appendices provide more detailed information to assist the reader.

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