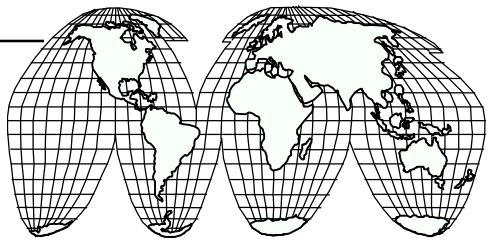
RTCA

Government/Industry Operational Concept for the Evolution of Free Flight

Addendum 3:
SURVEILLANCE

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



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SURVEILLANCE

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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

Surveillance provides a view of operations within the National Airspace System (NAS). Safety and efficiency are the essentials of this system. As the demands of capacity and efficiency grow, so must our ability to assess the immediate and evolving operations within the NAS. Safety and efficiency can improve when a common understanding of system participant needs and desires are known, and appropriate procedures and technologies applied. Surveillance plays an integral role in the NAS in separation assurance, traffic flow management, flight planning, fleet management, collaborative decision making, and collision avoidance. This document discusses those needs and our opportunities to advance system performance as they have evolved since RTCA published the *Government/Industry Operational Concept for the Evolution of Free Flight* in December 1997. Fundamental to this concept is the recognition that safety is the keystone to future enhancements. The path to enhanced safety also provides an opportunity to increase both efficiency and capacity. Improving the dissemination availability and quality of surveillance information represents one fundamental means by which safety, efficiency, and capacity will be enhanced.

In this document, **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, to provide situation awareness to pilots and controllers, and to 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 surveillance concept of operations is intended to document one of the essential elements of Free Flight. It is part of an overall government/industry activity to look at the evolution of surveillance services and of the surveillance architecture. A companion document describes the surveillance technology, architecture, and a roadmap needed to achieve the operational concept described herein. Along the way, evaluation of procedures, technologies, advances in Human Computer Interface (HCI), and domestic and international policies will shape the final outcome. In addition, there are other efforts currently underway in international fora, such as Eurocontrol and International Civil Aviation Organization (ICAO), to promote a global airspace, which provides increased capacity, efficiency, cost effectiveness, and safety across international boundaries.

The approach described herein transitions from the current radar/interrogator baseline of surveillance information to a digital information environment that encompasses air and ground operations. This approach focuses on providing shared real-time surveillance

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information to service providers (using automation to manage aircraft separation in all operations) and to pilots (utilizing new technology to aid in those aircraft management and separation services). Information requirements and revised procedures will be derived from the concept of operations to enhance safety and increase capacity, where appropriate.

This document focuses on these operational needs, so that there can be a common understanding of the aviation community's expectations for surveillance and so that the investment decisions in the NAS architecture can be validated against defined operational needs. Because surveillance plays a role in separation assurance, conformance monitoring, collision avoidance, traffic flow management, flight planning, fleet management, and collaborative decision making, an operational concept is needed that clarifies the extent of surveillance information needed, its required quality, and the system-wide treatment of differing levels of surveillance. In many cases, new operational benefits are anticipated based on improved operations. For many of these operations, more surveillance information is required to meet increased needs of service providers and users. Each environment—ground, terminal, en route, oceanic and ramp—has individual and interconnecting needs. These needs transcend traditional service provider and user requirements to serve as the basis for creation of a future system wherein the users have greater control of the operational outcome. The intent of this concept is to document these concepts in a technology-independent manner.

Within this document, a number of principles form the foundation of the operational concept for the role of surveillance, especially with respect to separation assurance. These key principles, as outlined below, are essential.

- The overriding premise in managing air traffic is safety.
- The operational objectives of new concepts include improved capacity and efficiency in all weather and visibility conditions, to accommodate increasing demands.
- The surveillance system provides uniform availability of shared, rich, and reliable data to service providers and users of the NAS.
- Development of procedures and training of controllers and users are essential.
- Training, supporting, and developing roles are performed in a supportive culture rather than one focused on punitive regulatory enforcement aspects or decertification.
- Common, consistent separation standards are applied based on required total system performance (RTSP) in that environment, rather than by airspace designation (e.g., terminal, en route).
- User equipage is benefits driven, and is not forced by mandate or additional restrictions on airspace access.
- New means of achieving separation objectives do not fundamentally change the nature of interactions between pilots and AT service providers.

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Key surveillance-related concepts in the evolution of the NAS to allow greater user flexibility are the following:

- Separation assurance is the responsibility of the AT service provider. In the future, for specifically certified and approved operations, separation responsibility may be delegated to the pilot, who uses on-board capabilities to both monitor and assure separation.
- Airborne and ground situation awareness is enhanced by new surveillance technology. This is especially significant for allowing positive separation in non-radar environments.
- The oceanic environment evolves to allow procedures that more closely resemble the en route environment.
- Improved surveillance information is provided in a timely and consistent manner across the NAS for planning and decision making. This information is available through various audible, graphical, and textual means designed to meet the needs of the human-centric tasks involved. This information enables decisions to be based on a shared consistent view of situations, even as conditions are changing. It is envisioned that the sharing of this information will be facilitated via a NAS information system.
- Improved surveillance, in combination with other capabilities and new procedures, enable capacity and safety improvements. These benefits accrue from increased situation awareness by decision makers and improved performance of decision support and analysis tools that use surveillance information.
- The future airspace environment will include aircraft operating without people onboard, which will have special surveillance information requirements.
- In order for Special Use Airspace to be used by all system users more efficiently, the status of surveillance information in that airspace is shared between the Department of Defense (DoD) and other system participants.
- Equipage for all users will be benefits based.

In summary, new cockpit and ground capabilities that build on improved surveillance provide pilots and service providers additional tools to achieve separation objectives. However, they do not fundamentally change the nature of interactions between pilots and controllers. The FAA continues to be responsible for establishing new procedures and ensuring that the tools supporting them are operationally suitable. These new procedures support greater flexibility, enhanced safety, and increased capacity. These essential new procedures are codified as a set of Extended Flight Rules (EFR). Some of these procedures result in delegation of separation responsibility to the pilot. In all cases, controllers continue to have the discretion of when to apply these procedures; pilots will continue to have discretion in requesting or accepting procedures. The development of improved surveillance capabilities and the critical EFR procedures to employ them are essential to user safety, flexibility, and traffic growth.

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1.0 Introduction

Surveillance provides a view of operations within the National Airspace System (NAS). Safety and efficiency are the essentials of this system. As the demands of capacity and efficiency grow, so must our ability to assess the immediate and evolving operations within the NAS. Safety and efficiency can improve when a common understanding of system participant needs and desires are known, and appropriate procedures and technologies applied. Surveillance plays an integral role in the NAS in separation assurance, traffic flow management, flight planning, fleet management, collaborative decision making, and collision avoidance. This document discusses those needs and our opportunities to advance system performance as they have evolved since RTCA published the *Government/Industry Operational Concept for the Evolution of Free Flight* in December 1997. Fundamental to this concept is the recognition that safety is the keystone to future enhancements. The path to enhanced safety also provides an opportunity to increase both efficiency and capacity.

In this document, **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 surveillance concept of operations is intended to document one of the essential elements of Free Flight. It is part of an overall government/industry activity to look at the evolution of surveillance services and of the surveillance architecture.

The future capabilities described in this operational concept cover a period of approximately the next two decades, and are defined in terms of near term, transition, and mature state. Near term covers the time period until about 2005. The mature state is anticipated to be accomplished by 2020. The transition phase refers to a period between the near term and mature state that would result in an orderly transition of the NAS. It is recognized that all capabilities within one of those three phases may not be implemented simultaneously, but may be implemented singly or in logical groups to assure a smooth and safe transition.

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1.1 Backgound

With the completion of RTCA's Task Force 3 on Free Flight, a number of goals were established for NAS modernization. Chief among these goals was the elimination of restrictions to flight operations, and the recognition of economics as a critical factor in both user and system equipage decisions. The NAS Architecture is the Federal Aviation Administration's (FAA's) plan to modernize the NAS in support of these goals, with priorities for improvements based on budget considerations, benefits, technical development, and other factors.

This surveillance operational concept was developed by the Select Committee on Free Flight Implementation to respond to government and industry desires to ensure that the NAS architecture truly reflects the most appropriate path for the evolution of surveillance capabilities in the NAS. In addition to the development of an overall operational concept for the role of surveillance in air traffic operations, a number of new concepts are being evaluated through the Safe Flight 21 program, which builds on the Free Flight Operational Enhancements recommendations from the Select Committee in August 1998. A significant number of these new concepts build on improved surveillance in both the cockpit and on the ground. These include broadcast of flight information to the cockpit, avoidance of terrain, improved terminal operations in low visibility, enhanced see-and-avoid, delegation of separation to the cockpit, improved surface navigation, enhanced airport surveillance for the controller, enhanced surveillance in non-radar airspace via ADS-B, and establishment of ADS-B separation standards. These activities, in addition to those of RTCA Special Committee 186 on Automatic Dependent Surveillance-Broadcast (ADS-B), lay the foundation for implementation of surveillance improvements. The surveillance operational concept is consistent with the specific concepts being explored via Safe Flight 21 and SC186.

The approach described herein transitions from the current radar/interrogator baseline of surveillance to a digital information environment that encompasses air and ground operations. Shared real-time information is used by AT service providers to manage aircraft separation in all operations. As the capabilities outlined here mature, information requirements and revised procedures will be defined, providing increased capacity, and, where appropriate, reduced separation, while maintaining or enhancing safety.

1.2 Scope of Document

This document focuses on NAS operations that build on the use of surveillance information. The primary role of surveillance is in separation assurance; thus, much of this document discusses concepts for separation assurance and how improved surveillance information provides operational benefits. Weather detection and data dissemination, while forms of surveillance, are treated here only to the level the information would affect operations. General flight planning and management services, including search and rescue, also involve surveillance information exchange, although the requirements are generally less demanding than

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those for separation assurance. Flight planning and management services are also outlined, but in lesser depth.

This document focuses on the operational use of surveillance, not the technical or architectural aspects of providing the information to those needing it. As such, this document includes needs for the human-computer interface and for tools that substantially build on surveillance. This document does not address which surveillance technologies can meet any particular need. A basic assumption is that equipage of new capabilities is voluntary, based on the delivery of new or improved user benefits. The intent of this concept is to document these needs in a technology-independent manner.

Because future concepts for separation assurance involve the potential adjustment in roles and responsibilities, with implied needs for surveillance to support these new operations, this document also addresses separation responsibility and the roles of pilots and controllers. In addition, functional dependencies and needed information are indicated. Many of the capabilities envisioned require analysis and validation before implementation can be accomplished and benefits accrued. Validation activities such as Safe Flight 21 are critical to move the vision expressed here to operational reality.

1.3 Objective and Intended Use

This document defines a vision for NAS operations that build on improved surveillance. This vision, in turn, is the basis for a roadmap for the evolution of the NAS surveillance architecture and surveillance capabilities. The roadmap outlines the investments that are needed to implement this vision and provide a context so that investment decisions in the NAS architecture can be validated against defined operational needs.

1.4 Document Organization

Section Two provides key principals guiding the operational concept and outlines concepts that apply across multiple domains of operation.

Then, in order to convey a meaningful concept of operations, Section 3 is organized according to recognizable operational domains involved in preparing and conducting a flight through the NAS.

For each domain, the operational concepts are presented in an evolutionary format, where only the changes envisioned for each time period (near term, transition, and mature state) are described.

A Bibliography provides information on documents referenced here as well as other documents relevant to this surveillance concept of operations.

Terms used in this document are listed in the Glossary.

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