

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 6: Aeronautical navigation issues

- 6.2 Navigation policy issues in the light of present and envisaged GNSS services
: and architectures, integration and back-up options**

PERFORMANCE-BASED NAVIGATION IN THE FUTURE ATM SYSTEM: HARMONIZING THE TRANSITION TO AREA NAVIGATION AND REQUIRED NAVIGATION PERFORMANCE OPERATIONS

(Presented by the United States)

SUMMARY

This paper describes United States commitment to and implementation strategy for area navigation (RNAV) and required navigation performance (RNP) and highlights the issues related to achieving the benefits and changes both within the United States and internationally. The FAA's goal in implementing RNAV and RNP is to assist in the transition from the current ground-based system to a performance-based navigation system.

Performance-based navigation, as an airspace management concept, is a powerful tool to make more efficient use of airspace and create significant operational benefits as a capacity-enhancement measure. The United States is implementing performance-based RNAV procedures that take advantage of the capabilities of existing aircraft, and is beginning the application of RNP where it can create additional capacity enhancement. RNP functionality is being delivered daily in airplanes all over the world. The key to the evolution of RNP is to adopt a strategy that embraces current operational capabilities to the maximum extent possible, provides a series of opportunities for enhancing operations, and adopts a benefits-driven vision for future operations that can be used as the basis for investments and changes. These benefits will only be fully realized if a harmonized global strategy is developed through ICAO.

Action by the conference is in paragraph 5.

1. INTRODUCTION

1.1 The navigation element of communications, navigation, and surveillance/air traffic management (CNS/ATM) must provide an accurate, reliable and seamless global navigation (and positioning) capability. Navigation (and positioning) is established using an appropriate mix of aids encompassing satellite, self-contained and ground-based navigation aids.

1.2 Vital to the CNS/ATM concept is the application of area navigation (RNAV), enabling aircraft to make use of global navigation satellite system (GNSS) and to allow air traffic management (ATM) to provide the flexibility of operations required to meet the future ATM requirements. Industry has worked since the early 1990s to establish equipment that will provide the required navigation performance to enable reliance to be placed on the RNAV system.

1.3 The United States is currently implementing performance-based RNAV procedures and airspace restructuring to take advantage of aircraft navigation capabilities to fly more accurate and predictable flight paths through United States airspace. Performance-based RNAV will result in increased levels of navigation accuracy and flight path predictability, leading to improved efficiency and capacity. The United States is also implementing required navigation performance (RNP) approach procedures and developing a strategy for the introduction of RNP for other phases of flight.

2. BACKGROUND

2.1 RNAV is a method of navigation that permits aircraft operation on any desired flight path, and RNP is the statement of the navigation performance accuracy necessary for operation in an area or necessary for a specific procedure. RNAV capability and the development of RNAV routes and navigation systems are key building blocks for performance-based procedures and airspace design. Another key building block is the determination of new minimum performance-based criteria and functional requirements for specific RNP operations in different operational domains.

2.2 The use of RNAV facilitates the implementation of a flexible route system. The application of RNAV in various parts of the world has already been shown to provide a number of advantages over more traditional forms of navigation and to provide a number of benefits, including:

- a) new approach procedures with vertical guidance for use at runways without instrument landing system (ILS) or when ILS is out of service;
- b) more direct routes permitting a reduction in flight distances and time;
- c) dual or parallel routes to accommodate a greater flow of en-route traffic;
- d) bypass routes for aircraft over-flying high-density terminal areas; and
- e) alternatives or contingency routes on either a planned or an ad hoc basis.

2.3 These benefits are dependent on a supporting navigation infrastructure. The Federal Aviation Administration (FAA) plans to take full advantage of the RNAV capabilities supported by GNSS and the existing ground-based infrastructure, principally through DME/DME navigation.

2.4 The benefits are also dependent on aircraft being equipped with RNAV equipment. These systems have developed since the 1960s and many aircraft are already equipped. The main standard for these systems was developed in the 1960's by the FAA (AC 90-45), is still in use, and is referenced in other standards (e.g. the European requirements for basic RNAV). Modern systems offer greatly improved capabilities, including an RNP capability.

2.5 An important feature of the RNP concept is that it allows the level of navigation performance required for a procedure or airspace to be specified based on the operation. The requirements for RNP procedures are defined based on the operational requirements, rather than the performance capability of a particular navigation system. RNP defines the navigation requirement and is only one factor in establishing required separation minima, which also considers communications, surveillance and air traffic management.

2.6 There are a number of issues that need to be addressed to successfully implement performance-based navigation. Some of those issues were recognized by the fourth meeting of the Global Navigation Satellite System Panel (GNSSP/4) held 23 April to 2 May 2003, and resulted in a recommendation to the Air Navigation Commission (ANC) to create a study group to coordinate among the relevant ICAO groups. This recommendation was adopted by the ANC on 29 May 2003.

3. DISCUSSION

3.1 United States strategy

3.1.1 The FAA is committed to developing and implementing a plan to establish performance-based airspace and procedures. The FAA published a roadmap for performance-based navigation on 22 July 2003. (This document is provided in AN-Conf/11-IP/41 and can also be found online at <http://www.intl.faa.gov>.) Furthermore, the FAA has established an RNP Programme Office to develop an implementation plan to carry out that commitment. The FAA also established a collaborative government/industry forum called the Terminal Area Operations Advisory Rulemaking Committee (TAOARC) to collaborate on the roadmap and to facilitate the development of criteria, standards and guidelines for implementing RNP.

3.1.2 An objective for RNAV and RNP for the United States in the near-term (2003-2006) is to leverage the current fleet of RNAV and RNP capable aircraft. The FAA will publish RNP-2 routes in the en route and terminal environment, and will leverage flight management systems capabilities through introduction use of parallel offsets. En route procedures based on a series of waypoints (Q routes) will be published in 2003 and converted to RNP-2 by 2005 with reduced separation criteria based on aircraft capabilities. The FAA will publish RNAV standard instrument departures (SIDs) and standard terminal arrivals (STARs) at airports where operators are capable and where the capacity, efficiency and predictability benefits are required. RNP-2 SIDs and STARs will be developed and published where operationally feasible and beneficial. In the near term, the FAA will publish baseline RNP-0.3 approaches where operationally beneficial. Approaches with vertical guidance will be provided for enhanced safety. RNP parallel approach transition (RPAT) procedures will be implemented for improved access during marginal weather conditions at seven United States airports with closely spaced parallel runways. En route, terminal and approach

procedures based on special aircrew and aircraft authorization required (SAAAR) will be defined and published where feasible and beneficial for operators and ATC. These SAAAR procedures introduce RNP values less than 0.3 for the approach and missed-approach, utilize approach segments other than straight-in and straight-out, and reduce vertical obstacle clearance surfaces for improved access and safety.

3.1.3 In the mid term (2007-2012), the FAA will mandate RNP-2 operations above FL 290. RNP-1 routes will be implemented in the en route and terminal environment where operationally beneficial. RNP approaches will become prevalent in this time frame. In the far term (2013-2020), RNP implementation will be characterized by increasingly complex procedures based on the evolution of the aircraft fleet and ground automation systems. RNP-1 operations will be prevalent in the en route (except low altitude where operators are not capable) and busy terminal environments. At the end of the far term, RNP-1 will be mandatory for IFR operations in all Class B airspace (en route transitions and SIDs/STARs associated with satellite airports are not subject to this mandate). Airspace redesign will maximize airspace benefits. The navigation infrastructure will be based primarily on satellite navigation with a basic network of ground based navigation aids to provide backup.

3.2 Key implementation issues were recognized at the GNSSP/4 meeting. As a result, an ICAO study group has been established to be a focal point for RNAV and RNP development. The study group has to address several core issues to develop the framework for implementation, and then coordinate the efforts of several relevant panels to define or update the operations approval criteria (OPSP), the obstacle clearance criteria (OCP), and separation criteria (SASP). In addition, there are a number of implementation issues that should be harmonized such as standardization of RNAV and RNP terms, flight plan suffixes, air traffic procedures, concepts for waypoint naming and usage, and charting.

3.3 The United States, Europe, and other ICAO regions share similar goals to improve safety, economic performance and environmental impacts of their respective air navigation systems. Air navigation requirements should no longer specify the technology to be used but instead specify the level of performance needed. These performance requirements should be driven by target levels of safety with consideration for operational efficiency and other economically-driven as well as environmentally-driven benefits. Without balancing these various aspects of performance, operational performance risks may be introduced.

3.4 ICAO Member States and operators who fly within their airspace are making investments in their navigation infrastructure as they implement new RNAV and RNP procedures. As these procedures are developed and used, these States are modifying separation standards to account for enhanced aircraft navigation capability, and redesigning airspace for best use of these new procedures. The schedule for implementation of new requirements should be coordinated to align with infrastructure investments and to allow operators sufficient time to equip with the needed capabilities.

4. CONCLUSION

4.1 Recognizing that implementation strategies are underway in the United States and other ICAO Member States, and RNAV and RNP Standards are under development by several ANC technical panels, there is an urgent need for global harmonization of performance-based navigation strategies among ICAO Member States.

5. ACTION BY THE CONFERENCE

5.1 The conference is invited to agree on the following recommendation for performance-based navigation:

Recommendation 6/xx —

That ICAO:

- a) by the end of 2004, develop a framework for the resolution of issues identified by GNSSP/4 and for the implementation of performance-based navigation operations; and
- b) by the end of 2005, define or update, as appropriate, the operations approval criteria, the obstacle clearance criteria, and the separation criteria for performance-based navigation operations.

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