AN-Conf/11-WP/90
5/8/03
English, French, Russian and Spanish only[1]

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

REQUIRED NAVIGATION PERFORMANCE

(Presented by European Organisation for the Safety of Air Navigation — EUROCONTROL, on behalf of its Member States and those of ECAC[2])

SUMMARY

The role of Required Navigation Performance in regard to area navigation (RNAV) applications is considered, with particular emphasis on issues related to functional requirements and cost-effectiveness.

Suggested action by the conference is in paragraph 4.

[1] French, Russian and Spanish versions provided by EUROCONTROL.

[2] The ECAC Member States are: **Albania**, Armenia, **Austria**, Azerbaijan, **Belgium**, Bosnia and Herzegovina, **Bulgaria**, **Croatia**, **Cyprus**, **the Czech Republic**, **Denmark**, Estonia, **Finland**, **France**, **Germany**, **Greece**, **Hungary**, Iceland, **Ireland**, **Italy**, Latvia, Lithuania, **Luxembourg**, **Malta**, **Moldova**, **Monaco**, **the Netherlands**, **Norway**, Poland, **Portugal**, **Romania**, Serbia and Montenegro, **the Slovak Republic**, **Slovenia**, **Spain**, **Sweden**, **Switzerland**, **The former Yugoslav Republic of Macedonia**, **Turkey**, Ukraine **and the United Kingdom**.

The 31 Member States of EUROCONTROL appear in **bold**.

1. INTRODUCTION

1.1 The Special Committee on Future Air Navigation Systems (FANS) developed the concept of required navigation performance capability (RNPC) to overcome the problem of defining specific airborne equipment for navigation in the manner described in Minimum Navigation Performance Specifications (ICAO Doc 8400). Following approval by the Air Navigation Commission, the Review of the General Concept of Separation Panel (RGCSP) was tasked with further elaboration of the concept. The RGCSP considered that, for airspace planning, measured performance was of more concern than equipment capability and changed RNPC to required navigation performance (RNP). RNP was adopted and originally identified a lateral navigation accuracy requirement. To cater for the approach environment, the RTCA DO-236A/EUROCAE ED 75a were further developed as standards for RNP in regard to area navigation (RNAV) applications. These added vertical accuracy to the original lateral accuracy requirement set out in DO-236 and ED 75.

1.2 It was generally expected that there would be a uniform application of the global navigation satellite system and that, through such application, a RNP would be achievable worldwide. The availability of GNSS would allow the capability to be achieved without reference to ground environment and would make it possible to define a uniform air traffic management (ATM) requirement that could be economically implemented on aircraft.

2. AREA NAVIGATION (RNAV) APPLICATIONS

2.1 The experience within the ECAC Member States area of the original Basic RNAV (B-RNAV) implementation, and the studies reviewing the future expansion of RNAV applications into terminal airspace are leading to the identification of limitations to the application of RNP. Whilst, for each implementation step, the initial aim was to identify only the RNP required, it was clear that, in order to maximize the operational advantages for RNAV, it was necessary to define a set of functional requirements. The problem with the establishment of the requirements is that RNAV systems, unlike the on-board VHF omnidirectional radio range (VOR) that determined previous navigation requirements, do not have a uniform capability. Each successive generation has increased or modified facilities and, unless there is a mandatory requirement, upgrades of installed equipment to the latest standard seldom occur.

2.2 This variation in capability was considered undesirable, not only because it was difficult for the capability of the RNAV system to be used to its full advantage but, more importantly, it resulted in aircraft, following identically defined tracks, actually following significantly different paths in space. This variation in performance represents a safety hazard. To overcome this, RTCA and European Organisation for Civil Aviation Equipment (EUROCAE) together started in 1993 to develop a minimum aviation system performance standards (MASPS) for an RNAV system which could become the basis of being the sole means of navigation and therefore allow potentially for the transition to a space-based navigation environment. The term used to define such equipment was “RNP-RNAV”, and the standard identified integrity, continuity of service, functionality etc. for such equipment.

2.3 The first version of the MASPS was published in 1996 and flight management systems have been produced since around 1998 claiming conformance to this MASPS. Unfortunately, none of the available systems yet meet all of the requirements, and the chosen subset of functions differs between manufacturers. Nevertheless, all claim to be RNP compliant. Given this situation, the need to gain early benefits and the need

for each region/area to identify a cost-beneficial transition plan, there is increasing realisation that even following the production of the MASPS the uniform, world-wide application of RNP will still not be achieved as was originally expected.

2.4 In addition, further versions of RNAV MASPS will continue to be developed. With 3D and 4D control being added, there will be an increasing range of functionality which could be associated with a given navigation accuracy. Thus, identification of RNAV capability by a RNP value is not an appropriate mechanism for defining requirements and, with the existing expectation of operators that they have "RNP certification", this can be the cause of significant confusion.

3. CONSIDERATIONS

3.1 Despite best efforts to develop and implement a cost-effective global definition of RNP-RNAV as set out by ICAO, it is unlikely that it can be achieved in the near future for the reasons outlined below:

3.2 The ability to rely on the uniform provision of GNSS without a reversion to ground-based environment is not expected to be achievable, at least for the foreseeable future. The need for an additional infrastructure prevents there being a uniform world-wide navigation capability. The performance for a given system will include accuracy limits which will be infrastructure, and hence location, dependent. Defining RNAV systems on the basis of a RNP value is therefore not appropriate.

3.3 Whereas a number of areas/regions might need a common accuracy requirement, they may not need common functionality. A specific example of this would be RNP 4 for remote/oceanic areas developed by the ICAO Separation and Airspace Safety Panel (SASP) to support a 30/30-NM separation. These are not going to present the same requirements as RNP 4 requirements of a dense continental airspace, where there is a need for close en-route spacing and specific functionality not needed in remote and oceanic operations. Mandating operators to equip to the most stringent requirements while their operations do not include those areas with the highest functional requirements is not going to be cost-effective, nor acceptable. Identifying both systems as RNP 4 will add further to the confusion.

3.4 The phased availability of RNAV functionality, as a consequence of the development of the flight management system, has led to many RNAV/FMS systems claiming RNP (x) capability but in reality possessing differing and incomplete functionality.

3.5 The need for a cost-effective implementation necessitates very careful definition of minimum functional requirements to maximize operator acceptance and hence maximize the ATM gains to be achieved from RNAV application.

3.6 The expectation is that there will be a continued gradual development of capability of on-board systems (including 4D RNAV) and a phased development of the ATM infrastructure. This will result in updating of minimum RNAV/FMS requirements as new ATM capabilities are implemented. It is unlikely that the timing of these developments can be coordinated world-wide and hence there is not likely to be a common world-wide certification or operational approval standard for navigation such as that which existed in the pre-RNAV period.

3.7 The experience from existing RNAV implementation has shown that operators, faced with detailed functional requirements, may not be able to identify which equipment can or cannot meet given RNP requirements, and often ask for assistance in the selection of compliant equipment.

4. ACTION BY THE CONFERENCE

4.1 The conference is invited to:

a) accept that, as a result of the need for cost-effective implementation of RNAV and the continual developments in on-board systems, it is unlikely that a uniform, world-wide definition can be achieved of functional and accuracy requirements that could be summarized in a single RNP value;

b) recognize that this fact and the expected further extension of RNAV into 3D and 4D navigation demands a flexible method by which navigation accuracy and functionality can be assigned; and

c) recommend that as there are requirements arising from the work of the ICAO GNSS Panel, Separation and Airspace Safety Panel and the Obstacle Clearance Panel, these three panels need to collaborate in a formal manner in order to define such a flexible identification.

— END —