International Civil Aviation Organization

The Eighth Meeting of the Performance Based Navigation Task Force (PBN/TF/8)

New Delhi, India, 12 – 13 May 2011

Agenda Item 4: PBN Implementation Issues

RNP Regional Interoperability

(Presented by Australia)

SUMMARY

This paper discusses the challenges associated with implementing RNP navigation specifications and presents a methodology to manage the inconsistency of navigation performance across the Region. The purpose of the methodology is to achieve technical, operational and regulatory interoperability when implementing RNP navigation specifications within the APAC Region. The objective is a seamless Regional ATM structure.

This paper relates to –

Strategic Objectives:

A: ***Safety*** *– Enhance global civil aviation safety*

C: ***Environmental Protection and Sustainable Development of Air Transport*** *– Foster harmonized and economically viable development of international civil aviation that does not unduly harm the environment*

Global Plan Initiatives:

GPI-5 RNAV and RNP (Performance-based navigation)
GPI-9 Situational Awareness
GPI-11 RNP and RNAV SIDs and STARs
GPI-21 Navigation systems

1. INTRODUCTION

1.1 The Performance-based Navigation (PBN) Manual (ICAO Doc 9613) has rationalised Instrument Flight Rules (IFR) navigation specifications into two categories; area navigation (RNAV) and Required Navigation Performance (RNP). The current and draft PBN navigation specifications are as follows:

- RNAV
  - RNAV 10
  - RNAV 5
  - RNAV 2
  - RNAV 1

- RNP
  - RNP 4
  - RNP 2 (draft)
  - RNP 1
  - RNP 0.3 enroute (draft)
  - RNP APCH
  - RNP AR APCH
  - RNP AR DEP (draft)

1.2 Despite the nomenclature of navigation specification type and value (ie: RNAV or RNP plus a numerical value) the PBN navigation specifications have been developed as standalone specifications and are not necessarily horizontally interoperable (RNP 1 to RNAV 1) or vertically hierarchical (RNP 1 to RNP 4). The lack of horizontal and vertical integration between the navigation specifications creates significant difficulty in implementation when attempting to achieve technical, operational and regulatory interoperability.

2. DISCUSSION

2.1 RNP navigation specifications can be flown by DME/DME or DME/DME/IRU equipped aircraft dependant upon the underlying terrestrial ATM infrastructure and by GNSS or GNSS/IRS equipped aircraft independent of the underlying terrestrial ATM infrastructure. In effect the PBN manual recognises two area navigation systems; those enabled by DME and those enabled by GNSS. However given the paucity of terrestrial infrastructure in many States and Regions, and in particular the density of DME's required to support RNP operations at values below RNP 2, it also recognises that GNSS is the primary area navigation system used to support RNP navigation specifications.

"While DME/DME-based RNAV systems are capable of RNP 2 accuracy, the increased complexity in the DME infrastructure requirements and assessment necessary to support an RNP 2 application means it is not expected to be practical or cost-effective for widespread application of DME/DME based RNP 2 " – PBN Manual 4th Edition (draft) Vol II , Part C, Chapter 2, Implementing RNP 2.

In fact GNSS is *required* for RNP 4, RNP 0.3 enroute, RNP APCH and RNP AR APCH and DEP and is acknowledged as the *primary* navigation system to support RNP 2 and RNP 1. In States or Regions with poor DME density, GNSS enabled RNP navigation specifications are the only implementation method available.

2.2 However, an unintended consequence of permitting both DME enabled and GNSS enabled area navigation systems in the RNP navigation specifications is the development of a value based area navigation enabled framework that accommodates uncertainty (inconsistency and unpredictability) of navigation performance. It is the inconsistency and unpredictability of navigation performance that creates impediments to interoperability as assumptions of performance, capability and standards cannot be made with any certainty based upon an operator's navigation authorisation. Rather, the aircraft navigation system and the terrestrial ATM infrastructure of the State or Region must be considered in context as there are simply too many variables to consider (aircraft navigation system, radionavigation aid type and density, altitude, range etc).

2.3 Australia is one such State that suffers from paucity of terrestrial ATM infrastructure and indeed consideration of DME/DME infrastructure is demonstrative of this fact. In Europe there is approximately one DME every 7000 km^2 , in the USA one DME every 9500 km^2 and in Australia one DME every 107 000 km^2 . As a result DME enabled area navigation is simply not possible in Australia. Consequently, Australia has developed a PBN regulatory structure that *requires* GNSS to hold any RNP navigation authorisation and has developed the regulations such that the PBN navigation authorisations are hierarchical. Australia also requires IRS equipage to hold any RNAV navigation authorisation. This is not to say that DME/DME cannot be used by an operator who is willing to demonstrate the required performance can be met by DME/DME; but rather for RNAV, IRS is the minimum area navigation system standard and for RNP, GNSS is the minimum area navigation system standard. By base lining the PBN navigation specifications in this way Australia has provided certainty of performance (consistency and predictability) and a resultant regulatory structure that is both horizontally and vertically integrated.

Note: It should also be recognised that ATM enablers such as GNSS derived separation standards, surveillance and lowest safe altitudes (LSALT) can be universally applied in the ATM when managing "GNSS RNP and IRS RNAV approved" aircraft.

2.4 In the context of the APAC Region a similar approach could be adopted. For ease of understanding, and to maximise the implementation of PBN, APAC could consider adopting the following approach: For RNP navigation specifications GNSS *must* be used; for RNAV navigation specifications GNSS *may* be used. This is a variation on the approach adopted by Australia but is less onerous for the RNAV specifications (ie: DME/DME becomes the minimum RNAV navigation system requirement not IRS).

2.5 Such an approach will harmonise technical, operational and regulatory RNP navigation specification requirements across the region and provide true interoperability across diverse ATM capabilities' and between FIR's. A harmonised global navigation specification structure with seamless operational approvals was is in fact an objective of PBN however the inclusion of navigation systems other than GNSS in the RNP specifications has resulted in conditional performance dependant upon the density of DME's available to support RNP operations. While this remains the case an RNP approval granted to an aircraft without GNSS will be conditionally dependant upon the supporting ATM infrastructure and as such will be not interoperable across multiple States or regions.

2.6 If APAC were to adopt GNSS enabled area navigation systems as the minimum requirement for all RNP navigation authorisations then any aircraft in the region would enjoy true technical, operational and regulatory interoperability. The same effect could be achieved globally were ICAO to adopt GNSS enabled area navigation systems as the minimum requirement for all RNP navigation authorisations.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) Consider the content of this paper,

b) Recommend to the APANPIRG that the APAC Region adopt, as a minimum requirement, GNSS enabled area navigation systems for all RNP navigation authorisations, and

c) Recommend that the APANPIRG recommend to ICAO to adopt, as a minimum requirement, GNSS enabled area navigation systems for all RNP navigation authorisations.

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