



WORKING PAPER

**FOURTEENTH MEETING OF THE CAR/SAM REGIONAL PLANNING AND
IMPLEMENTATION GROUP (GREPECAS/14)
(San Jose, Costa Rica, 16 to 20 April 2007)**

Agenda Item 2: Analysis of Global, Inter and Intra-regional activities

IMPLEMENTATION OF PERFORMANCE BASED NAVIGATION (PBN)

(Presented by the Secretariat)

SUMMARY

ICAO, assisted by the RNP Special Operational Requirements Study Group (RNP SORSG), has been working in regard to harmonizing the differing concepts, terminology and definitions utilized in RNP and RNAV applications globally. This paper provides up-to-date information on the work done by the RNP SORSG as well as ICAO plans for implementation of PBN based on that work.

Action by GREPECAS/14 is in paragraph 3.

1. INTRODUCTION

1.1 Within the international civil aviation community and among individual States, there exist a number of different perspectives in relation to several aspects of required navigation performance (RNP) and area navigation (RNAV). In particular, the naming conventions associated with RNP have not provided clear understanding regarding concepts, terminology and definitions, and different navigation specifications for similar RNAV applications have been developed. Consequently, divergences in regional implementations had resulted in a lack of harmonization between RNP and/or RNAV applications in different areas of the world.

1.2 In order to address the lack of global harmonization resulting from the differing RNP and RNAV naming conventions and proliferation of navigation specifications, ICAO, with the assistance of the RNP Special Operational Requirements Study Group (RNP SORSG), commenced work to ensure a common global understanding of RNP/RNAV and the relationship between RNP and RNAV system functionality.

1.3 RNP SORSG is reviewing RNP and RNAV to address current proliferation and to develop a basis for current and future requirements for performance based navigation (PBN). The study group's work is reaching a mature stage and the outcome is expected to be presented to the Air Navigation Commission in the first half of 2007.

2. DISCUSSION

2.1 In light of new technologies, capabilities and experience gained over previous years with RNP and RNAV implementations at the global level, discussions were focused on different perspectives and implementations of RNP and RNAV between the international civil aviation community and some individual States, which evolved towards a divergence of interpretations and resulted in a lack of harmonization.

2.2 In addition, there was a need among the industry community to develop RNP in the terminal airspace, as the current ICAO RNP provisions are insufficient to meet terminal airspace and approach requirements. In light of this, RTCA developed the RNP RNAV concept (RTCA DO236). The main differences between ICAO “RNP” and industry “RNP RNAV” is functional integrity¹ vs. containment integrity² and continuity.

2.3 ICAO Air Navigation Commission (163/9) approved the establishment of the Required Navigation Performance Special Operational Requirements Study Group (RNP SORSG) as the coordinating group. RNP SORSG identified that the main issue was that RNP, as currently defined by ICAO, did not specify the requirement for on-board performance monitoring and alerting., which is the function on board the aircraft that detects and informs the crew when the RNAV system is unable to satisfy the performance prescribed in the navigation specification.

2.4 Considering that the navigation containment is based on accuracy, functional integrity, continuity and systems availability, RNP SORSG agreed on the need to specify future applications of **performance based navigation without a requirement for on-board performance monitoring and alerting, to be designated as RNAV, and applications with a requirement for on-board performance monitoring and alerting, to be designated as RNP**, thereby addressing the current confusion and differences of opinion about what is RNP. The table below illustrates this.

Navigation Specification Designation	Current Scenario	New Scenario (PBN concept)
RNP x	<i>ICAO</i> : with or without performance monitoring and alerting requirement (vaguely addressed) <i>Industry (RTCA and Eurocae)</i> : Only with performance monitoring and alerting requirement	Performance monitoring and alerting requirement
RNAV x	<i>ICAO</i> : designations do not exist <i>States and Regions</i> : differing State and Regional designations do exist	No performance monitoring and alerting requirement

2.5 The work of the RNP SORSG is presently progressing very well, and in order to harmonize PBN between States, the RNAV and RNP applications were agreed as follows:

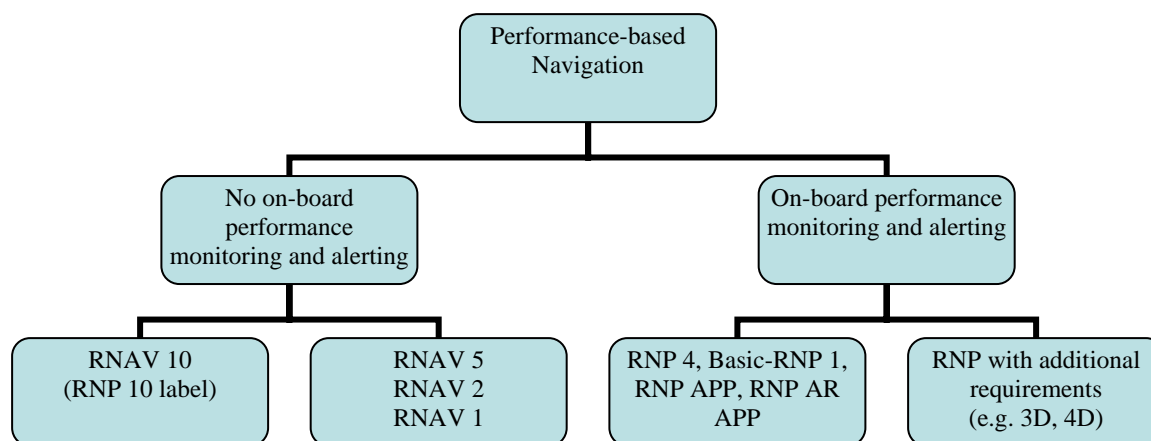
Area of	Navigation	Designation of	Designation of	Requirement for
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¹ Integrity: The ability of a system to provide timely warnings to users when the system should not be used for navigation. (ICAO *Manual of Required Navigation Performance*, Doc 9613)

² Containment integrity: A measure of confidence in the estimated position, expressed as the probability that the system will detect and annunciate the condition where the TSE is greater than the cross track containment limit. (RTCA DO236)

Application	Accuracy (NM)	Navigation Standard (current)	Navigation Standard (new)	performance monitoring and alerting
Oceanic/Remote	10	RNP 10	RNAV 10 (RNP 10 label)	no
	4	RNP 4	RNP 4	yes
Enroute – Continental	5	RNP 5 Basic RNAV	RNAV 5	no
Enroute – Continental and Terminal	2	US-RNAV type A	RNAV 2	no
Terminal	1	US-RNAV type B and P-RNAV	RNAV 1	no

2.6 In addition to the harmonization of nav specs, as indicated in the above table, new nav specs were developed. For terminal area applications, Basic-RNP 1 was developed, and for approach, RNP Approach and RNP AR Approach nav specs were developed. RNP 2 and Advanced-RNP 1 will be addressed in a future revision to the PBN Manual. The diagram below shows all the navigation specifications agreed on by the RNP SORSG, as well as where they fit in the overall PBN concept:



2.7 In addition, the Separation and Airspace Safety Panel (SASP) is in the process of drafting an amendment to Annex 11 – *Air Traffic Services*, Attachment B, “*Method of establishing ATS routes for use by RNAV-equipped aircraft*”, and its work includes updating relevant guidance material on safety and separation.

2.8 It should be noted that ICAO, with the assistance of the RNP SORSG and other ICAO bodies (such as SASP, Obstacle Clearance Panel and Navigation Systems Panel), is carrying out work to clarify all RNAV and RNP guidelines so as to ensure a common understanding of RNP and the relationship between RNP and RNAV functionality, facilitating at the same time global harmonization of existing applications as well as the establishment of the future basis of air navigation performance operations, in benefit to the entire global aviation community.

2.9 New ICAO SARPs and guidelines, with amendments to various ICAO Annexes, a revised *Performance Based Navigation Manual*, and other related provisions will soon be presented as follows:

- a) Revised RNAV and RNP terminology in the Annexes:

- State consultation 3rd quarter 2007
 - Applicable November 2008
- b) Performance Based Navigation Manual:
- Available on ICAO-NET as final draft: April 2007
 - State letter with all navigation specifications included: April 2007
 - Inclusion of Advanced-RNP 1: January 2008 (projected)
- c) Obstacle Clearance Criteria (PANS-OPS):
- State consultation 1st quarter 2008
 - Applicable late 2008 or early 2009
- d) ATC Separation Criteria:
- State consultation 3rd quarter 2008
 - Applicable November 2009

2.10 ICAO has established a tentative set of global goals for implementation of PBN.

2.10.1 For enroute and terminal area PBN operations (where RNAV operations are required):

- a) **Area of operation: Oceanic and remote airspace (RNP-X)**
- Applicable navigation specifications: RNP 10 and RNP 4
 - Implementation strategy: 100% implementation by 2010
- b) **Area of operation: Enroute continental (RNAV-X and RNP-X)**
- Applicable navigation specifications: RNAV 5, 2, and 1, RNP 2 and 1
 - Implementation strategy: 70% by 2010, 100% by 2014
- c) **Area of operation: Terminal area (RNAV-X and RNP-X)**
- Applicable navigation specifications: RNAV 1,2 and RNP 1 (Basic and advanced)
 - Implementation strategy: 30% by 2010, 60% by 2014, 100% by 2016

2.10.2 **Area of operation: Approach (RNP-X)**

- Applicable navigation specifications:
 - APV: RNP 0.3 , RNP 0.3-0.1,
 - LNAV-only: RNP 0.3
- Implementation strategy:
 - International aerodromes: APV to all runway ends: 10% 2008, 30% by 2010, 70% by 2014 and 100% by 2016.
 - Domestic aerodromes (where operations of a/c weight category of more than 5700 kg take place):
 - LNAV-only to all runway ends: 10% 2008, 30% by 2010, 70% by 2014 and 100% by 2016.
 - APV to all runway ends: 10% 2010, 30% by 2012, 70% by 2016 and 100% by 2018.
 - Domestic aerodromes:

- LNAV-only to all runway ends: 10% 2010, 30% by 2012, 70% by 2016 and 100% by 2018.

2.11 A Computer-based Training CD-ROM will be developed by EUROCONTROL and will be available by March/April 2007. Subsequently, workshops are tentatively planned for the CAR/SAM Region to be held in Mexico from 14 to 18 January 2008 and Lima from 21 to 25 January 2008.

3. ACTION BY GREPECAS/14

3.1 The Meeting is invited to:

- a) note the information provided in this working paper;
- b) identify issues/action items arising from the work of the RNP SORSG in order to facilitate regional and global harmonization of existing applications as well as future implementation of Performance Based Navigation operations;
- c) agree to implement PBN where required in the enroute and terminal (arrival and departure) environments, on a timetable that meets or exceeds the tentative global goals for implementation in paragraph 2.10.1 of this working paper;
- d) agree to implement APV approaches to all international runway ends, on a timetable that meets or exceeds the tentative global goals for implementation in paragraph 2.10.2 of this working paper; and
- e) agree to implement LNAV-only and APV approaches to all domestic runway ends, on a timetable that meets or exceeds the tentative global goals for implementation in paragraph 2.10.2 of this working paper.

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