



# **FROM RNP DIVERGENCE TO PERFORMANCE-BASED NAVIGATION CONVERGENCE**

**(Presented by the Secretariat)**



**Fifth meeting of ALLPIRG/Advisory Group  
(ALLPIRG/5)**

**Montreal, 23-24 March 2006**



# History

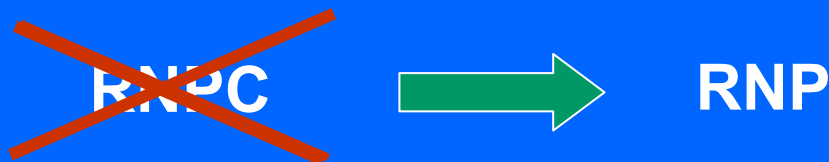
FANS identified need for performance based navigation and developed:

***Required Navigation Performance capability (RNPC) concept:***

**Parameter describing lateral deviations from assigned or selected track as well as along track position fixing accuracy on the basis of an appropriate containment level**



- 1990: RGCSF noted that capability and performance were distinctively different.
- Airspace planning needs measured performance, not designed in capability





# The problem

## Current ICAO RNP concept

Current applications:

- RNP 10
- RNP 4
- RNP 0.3

ICAO RNP provisions insufficient  
for terminal airspace and approach  
requirements

*Containment based on:*

- *Accuracy*
- *Integrity*
- *Continuity*
- *Availability*



# The problem

## Developments outside ICAO

- ➔ RNP concept has continued to evolve
  - RTCA/EUROCAE defined performance and functional requirements
  - Boeing and Airbus deliver “RNP” based on different versions of requirements



# The Problem

## Confusion

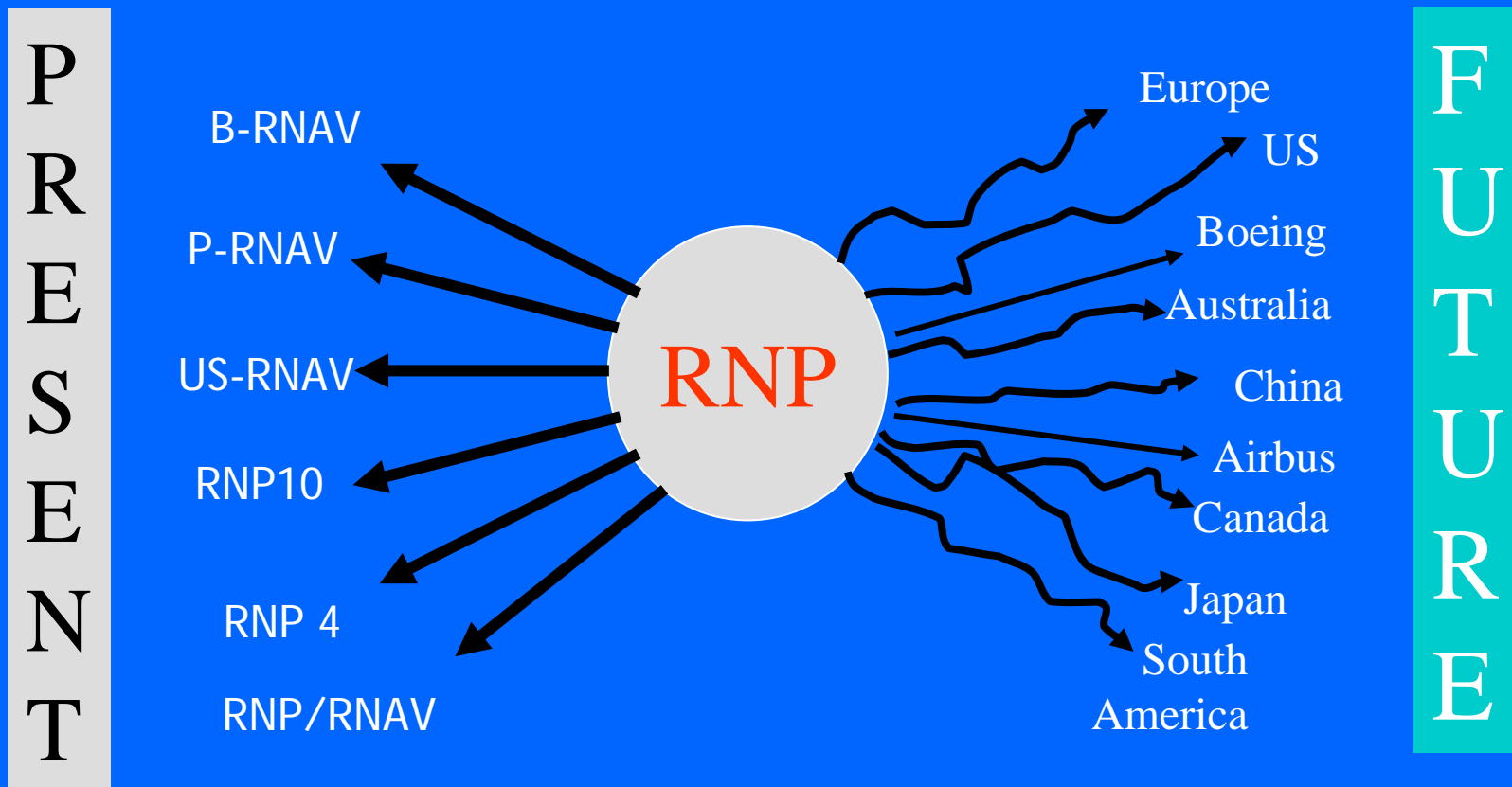
→ Discrepancy between ICAO regions  
and between ICAO and industry  
practices



Regions/States found different solutions (PRNAV,  
USRNAV, RNP/RNAV, etc)



# RNP Divergence



**Multiple navigation standards ....  
Costly for operators.**





# ICAO assessment

- Individual ANC Panels unable to address the problem
- Need for focal point in ICAO to address problems experienced with RNP Concept (GNSSP/4 recommendation 1/1)





# ANC decision

→ ANC (163/9) approves establishment of **R**equired **N**avigation **P**erformance **S**pecial **o**perations requirements Study Group (RNPSORSG) as coordinating group





# RNP SORSG

## Main goals

- Common understanding of the RNP concept and the relationship between RNP and RNAV functionality;
- Harmonize use of RNP and RNAV functionality on global basis, for benefit of operators.
- Identify operational requirements for RNP and RNAV



# RNPSORSG

## RNP Concept issues

Main issues:

- ➔ *On-board performance monitoring and alerting*
  - ICAO does not currently specify this
  - RTCA does specify, consistent with cockpit terminology
- ➔ Addition of functionality requirements



# RNPSORSG

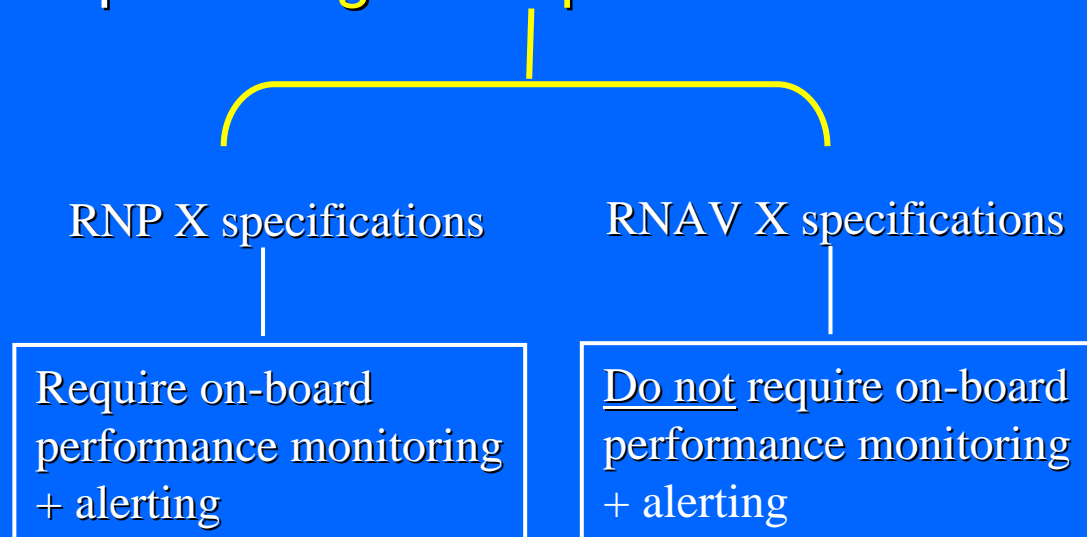
## RNP Concept issues

- *On-board performance monitoring and alerting function.* A 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*. This function should monitor all type of errors which may affect the aircraft ability to follow the desired flight path.
- The required level of on board monitoring and alerting is stipulated in each RNP specification.



# Agreeing PBN

➔ PBN specifies RNAV system performance i.e. accuracy, integrity, continuity, availability + functionality; – written up in **navigation specifications**



This is different to the RNP concept which stressed navigation accuracy and ‘stopped’ at *required performance*. However, PBN is anchored in detailed **navigation specifications** which contain **performance and functionality** requirements.



# Harmonizing PBN

- Common understanding of the performance based navigation concept and the relationship between RNP and RNAV functionality
- **Harmonization between States**



# RNP SORSG – Harmonization

**Simplification,  
reduced costs  
for operators  
and ANSPs**

Area of Application	Nav accuracy	Designation of navigation standard: <i>Current situation</i>	Designation of navigation specification: PBN concept <i>(new)</i>
Oceanic/ Remote	10	RNP 10	<b>RNAV 10</b>
	4	RNP 4	<b>RNP 4</b>
En Route - Continental	5	RNP 5 Basic RNAV	<b>RNAV 5</b>
En Route - Continental and Terminal	2	USRNAV type A	<b>RNAV 2</b>
Terminal	1	USRNAV type B <u>and</u> P-RNAV	<b>RNAV 1</b>



# RNP SORSG

## Approach concept

- Common understanding of the performance based navigation concept and the relationship between RNP and RNAV functionality
- Harmonization between States
- **Development of RNP 1 and 2**





# RNP SORSG

## RNP 1 and 2

- ➔ RNP 1 and 2 requires on board performance monitoring and alerting
- ➔ Is applicable in non-radar airspace
- ➔ Does not require additional functionalities such as RF leg, TOAC, vertical navigation with VEB, etc.
- ➔ Application: utilizes current equipment available in many aircraft i.e. GPS panel-mount avionics;
- ➔ Not intended for high-density airspace



# RNP SORSG

## Approach concept

- Common understanding of the performance based navigation concept and the relationship between RNP and RNAV functionality
- Harmonization between States
- Development of RNP 1 and 2
- **Development of concept for approach**



# RNP SORSG

## Approach Concept

On-board performance monitoring and alerting required

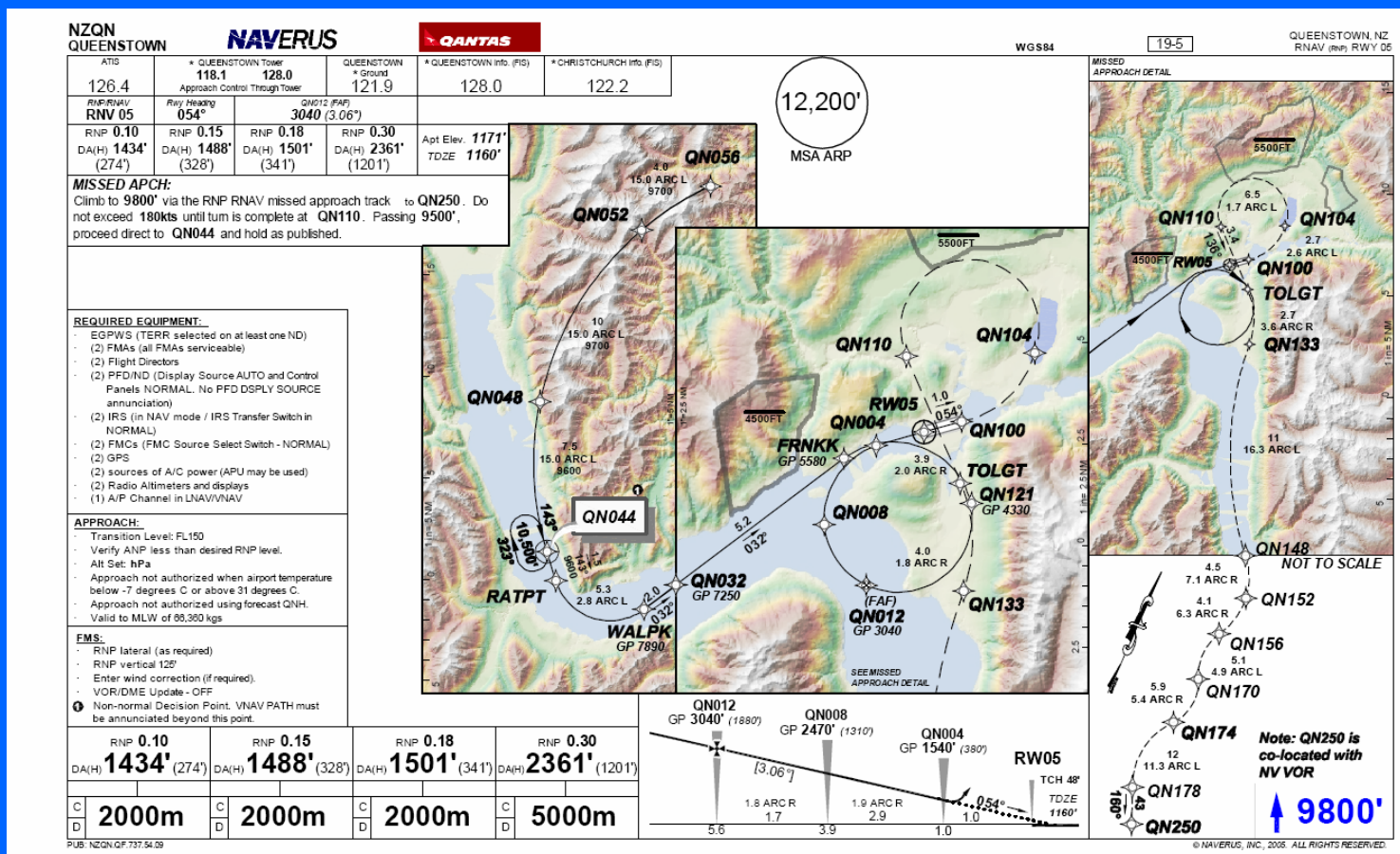
➔ Scaleable RNP (0.3 – 0.1NM)

➤ Functionalities: VNAV, RF legs

➤ Authorization required



# RNP 0.3 – 0.1 scaleable procedures





# RNP SORSG

## Approach Concept

On-board performance monitoring and alerting required

### → Scalable RNP (0.3 – 0.1)

- *Functionalities: VNAV, RF legs*
- *Special authorization required*

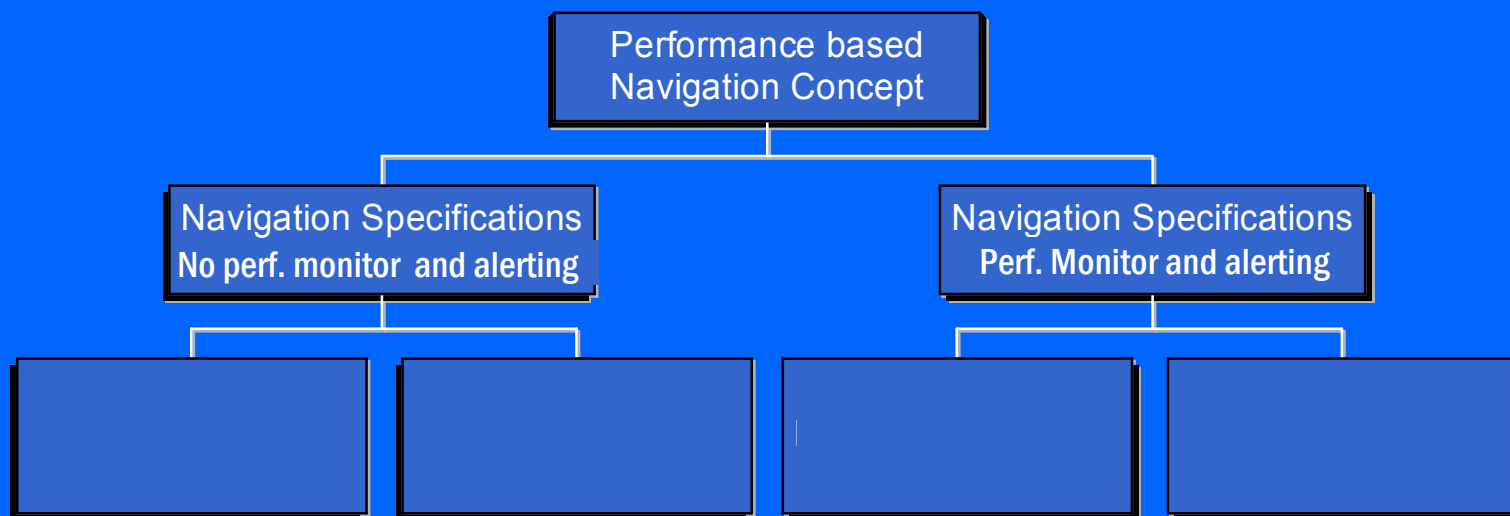
### → RNP (0.3NM) for lowest common denominator

- *Basic GNSS, SBAS*
- *Functionalities: VNAV, RF legs optional*
- *No Special authorization required*



# RNP SORSG

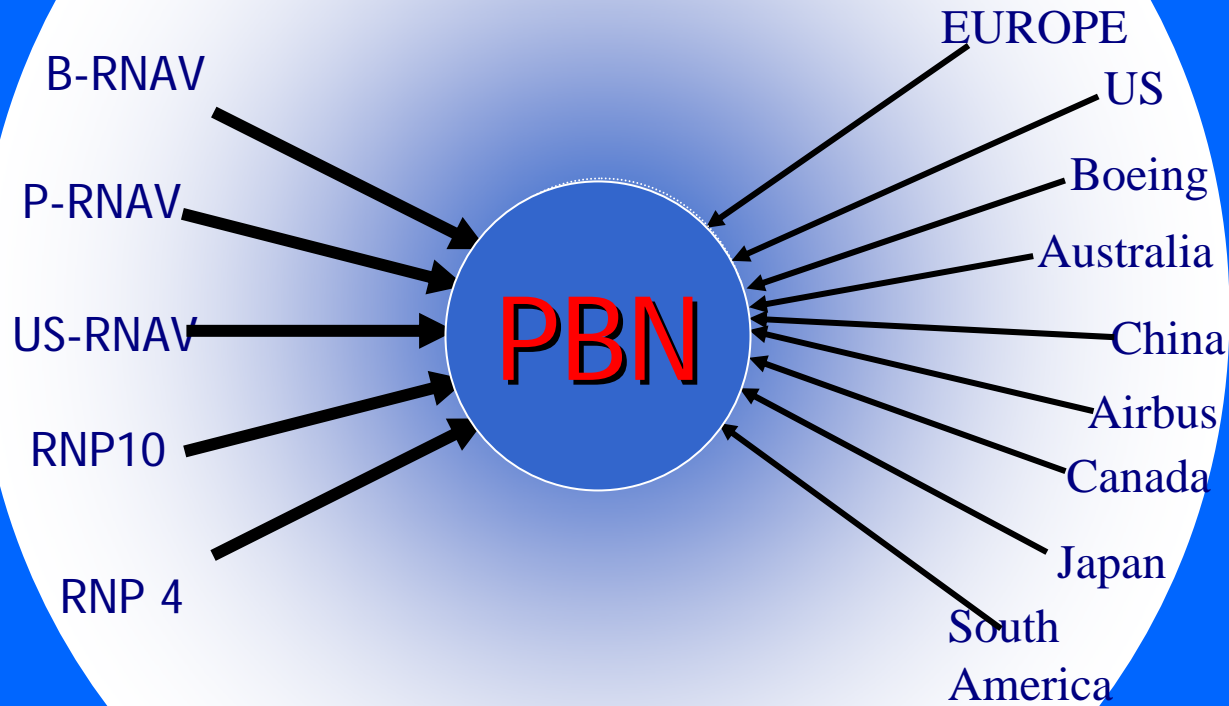
## Performance-Based Navigation Concept





# PBN Convergence....

P  
R  
E  
S  
E  
N  
T



F  
U  
T  
U  
R  
E



# RNP SORSG Provisions

From concept to ICAO provisions ...





# ICAO Provisions

## Performance-Based Navigation Manual

- ➔ PBN Manual to provide a “one stop shop” for States how to implement RNAV and RNP in their airspace
- ➔ PBN Manual being developed: Two Volumes:
  - Volume I – An Application of RNP and RNAV
    - Concept of PBN and how it is used
    - Implementation Guidance to States / Regions

- Volume II – Compendium of Navigation Specifications

**RNP10**

**RNAV 2**

**RNP 1**

**RNP 4**

**RNAV 1**

**RNP 0.3**

**RNAV 5**

**RNP 2**

**RNP 0.3-0.1**

**Limit number of Navigation Specifications by encouraging use of specifications in Volume II**



# ICAO provisions

## *Standards*

Annex 2, 4, 6, 10, 11 and 15

## *Procedures*

PANS-ATM, PANS-OPS, regional SUPPS

## *Manuals*

Manual on Performance based navigation

Manual on RNP/AR procedure design



# Need for Global implementation programme

*From Provisions to **Implementation** ....*



# Need for Global implementation programme

- Create awareness and acceptance
  - Training and awareness material
- Ensure implementation
- Ensure centralised maintenance of the concept
  - Gap analysis
  - Future expansion based on ops needs

*Through implementation to **PBN** convergence*



# Conclusions

- Global level:
  - Finalization of ICAO provisions
  - Development of tools to increase awareness and training (CBT, train the trainer)
- Regional level:
  - Increase awareness (organize workshops, training)
  - Implement performance based navigation based on regional requirements
- Global – regional:
  - Establishment of proper coordination throughout implementation



# Actions by ALLPIRG/5

The ALLPIRG/5 meeting is invited to:

- a) *note* the actions being undertaken in updating ICAO provisions;
- b) *note* awareness material being developed;
- c) *agree* to increase awareness and understanding of performance based navigation concept and its elements (organize workshops, training); and
- d) *agree* that where based on regional requirements RNAV is required, this will be implemented according to the performance based navigation concept.



**END**

*Thank you for your attention!*