

# ICAO-IATA PBN Webinar

Updates to the PBN manual  
*Edition 5*

7 JUL 2022



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# Today's Schedule

( Schedule)

60min.. Presentation

25min.. Q&A for Edition 5

20min.. Q&A from registration form

( Rule)

- **Your microphone is kept muted**
- Please **use "question function" to send your question**
- Moderator will ask the posted question to the presenters in Q&A session. ( Not answer to the posted question directly)

*Note: PBNSG will review other questions and publish the Q &A document after the webinar .*

# Presenters from PBN Study Group

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Facilitator

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# Opening

Fifth Edition of ICAO PBN Manual ( Doc 9613)

## **Focus:**

No brand-new navigation specifications in fifth edition, more update of current specification and clarification.

## **Scope of this Webinar:**

- Brief on forthcoming changes in the Fifth Edition of the ICAO PBN Manual Doc 9613.
- Hold a Q & A session on aspects of Edition 5 from the briefing and any other implementation issues, relating to operational authorization.

# Key change points

Ian Knowles

10 August 2022

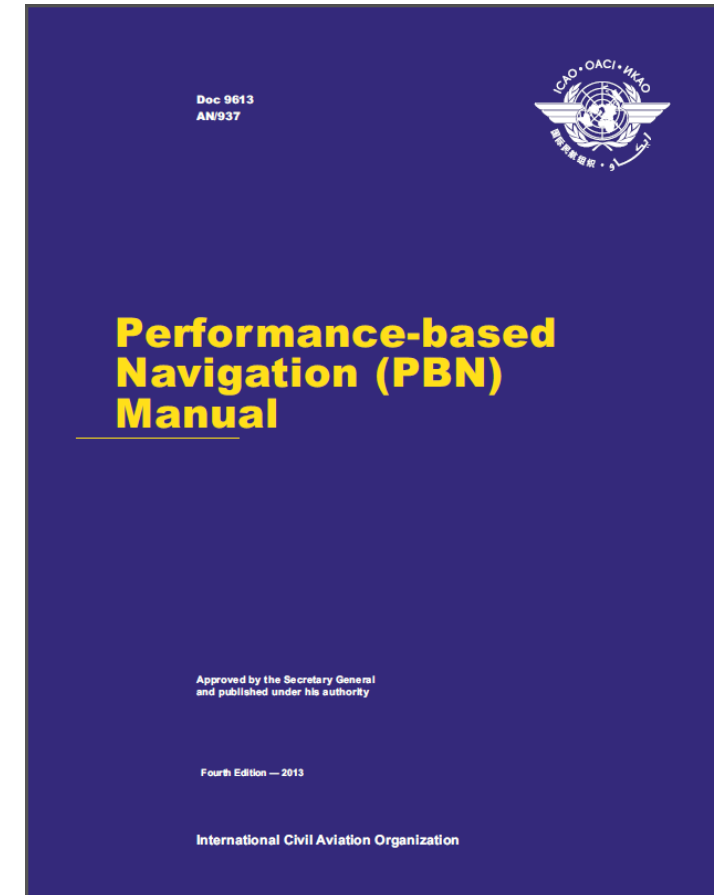


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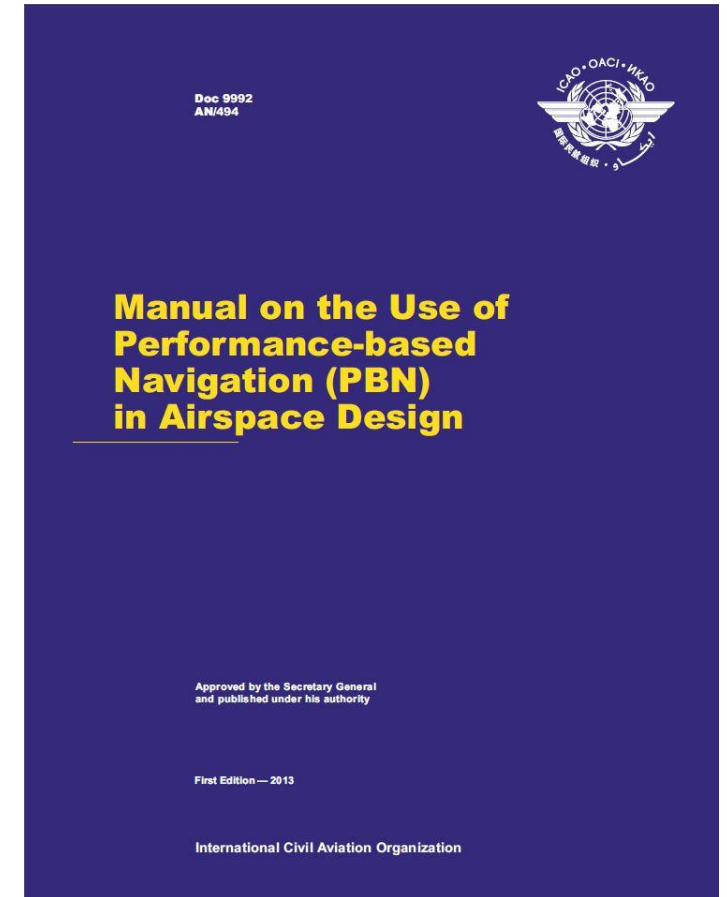
# Key points of ED5 changes

- PBN Manual Structure:
  - **Vol I – Concept and Implementation guidance**
    - Description
    - Airspace concepts
    - Uses
    - Part B – Implementation guidance
  - **Vol II – Implementing RNAV and RNP Operations**
    - OBPMA
    - Safety Assessments
    - Part B - Implementing RNAV/RNP Ops
- Overall structure is retained in Edition 5



# Structural changes in ED5

- **Changes to Vol I:**
  - Removed duplicated information in Doc 9992 - *PBN Airspace Design*
    - Part B – Implementation guidance
    - Attachment C
  - Clarifications and additions:
    - Use of RF legs
    - PBN Free routes
    - Selection of RNAV or RNP nav spec
    - Reversion following GNSS loss



# Key changes in ED5

- **Changes to Vol I:**

- Clarifications and additions (cont.)

- All Area Navigation is PBN

*Area navigation.* A method of navigation which permits aircraft operation on any desired flight path within the coverage of ground or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

~~Note. Area navigation includes Performance-based Navigation as well as other RNAV operations that do not meet the definition of Performance-based Navigation.~~

- Holding

- GBAS as a positioning sensor

*(Note: GBAS approaches are not PBN)*

- Terminology for Authorization, Acceptance and Approval  
(From Flight Ops Panel work on Annex 6)



# Key changes in ED5

- **Changes to Vol II:**
  - Baro VNAV Attachment removed
  - New Attachments included:
    - RNP APCH and RNP AR APCH ops in non-standard temperature
    - MagVar
    - Document references
  - Updates to OBPMA
    - Part A, Chapter 2 updated
    - Nav Spec text aligned

# Key changes in ED5

- **Changes to Vol II (cont.):**
  - GNSS
    - DFMC included
    - Monitoring requirements
  - Clarification of terminology:
    - Nav Spec (RNP 0.3, RNP 1)
    - Lateral Navigation Accuracy (RNP 0.30, RNP 1.0)
    - Inertial Navigation System (to cover INS, IRS, IRU)

# Key changes in ED5

- **Changes to Vol II (cont.):**
  - RNP AR
    - RNP AR DP introduced
    - Combined in Chapter 6 – Implementing RNP with Authorization Required (AR)
    - Update to FOSA material and two-tier authorizations
  - Changes to Advanced RNP (A-RNP)
  - RNP 0.3 (Navigation Specification)
    - Exclusively for Helicopters

# Publication timetable

- Technical content complete Q4 2021
- Review of terminology and consistency Q2 2022
  - Authorization, acceptance and approval (FLTOSP work)
  - Flight plans (FF-ICE related)
  - General consistency with other publications
- Editorial review Q4 2022
- Publication early 2023



# Related guidance material and activities

- **Update to the ICAO PBN Operational Approval Manual (Doc 9997)**
  - Currently being updated to Third Edition by the Flight Operations Panel.
  - Expected delivery Q4 2022
  - Publication in 2023
- **Update to ICAO Manual on the use of PBN in Airspace Design (Doc 9992)**
  - Considering update to the Second Edition
  - Support from CAEP (CCO and CDO)
- **Temperature correction/compensation (for Barometric defined instrument approach procedures)**
  - subject of a separate ICAO sub group formed from members of the Flight Operations and ATM Operations Panels.



# Changes in Vol 1 and in Vol2 from an airspace concept point of view

Benoit Roturier

10 August 2022



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# Global and comprehensive view on Nav Spec

- Volume II (Implementing RNAV and RNP), Part A (General) , Chap 1 (Introduction)
- **Edition 5 provides enhancement of scope and use of Nav Spec in airspace:**
  - [Table II-A-1-1](#) (improved) : nav spec vs flight phases, associated accuracy
  - [Table II-A-1-2](#) (**New**) : examples of airspace requirements and RNP system functions
  - [Table II-A-1-3](#) (**New**) : nav spec and system functions (required or optional)
  - [Table II-A-1-4](#) (**New**) : nav spec and NAVAID infrastructure (required or optional)

# Use of RF

- More aircraft are RF capable. More procedure designers use RF outside RNP AR navigation applications.
- **Edition 5 provides more information and guidance material for "judicious" use of RF legs:**
  - Volume I, Attachment A and Volume II, Part A, Chapter 1 provides an extensive list of considerations for the application of RF within airspace concepts
  - Volume II, Appendix 1 to Part C updated to include criteria for use of RF in CS/Part 23 aircraft with suitable CDI and moving map display in the pilot's primary field of view and not requiring an autopilot or flight director



# Clarification on Holding and Parallel offset capabilities

- Holding is not considered as a PBN function (no standardized functional requirements. (not listed in Table II-A-1-3)
- Parallel Offset is considered as a PBN function (required for RNP4 and A-RNP)
- However

"An airspace concept may include either of these two capabilities based on the assumption that the aircraft contains parallel offset and/or holding functions, or for those aircraft without parallel offset and/or holding functions, flight crews have the means, procedures and training to perform these aspects of flight operations."

(Vol II, Part A, Chap1 )

# Holding function in PBN Manual Edition 5

- A-RNP supports RNP Holding for future applications
- ANSPs may include holding procedures in their airspace design using a waypoint as holding point.

*Note: Holding patterns are to comply with the criteria and publication requirements in PANS OPS Volume II, Part 3, Section 3, Chapter 7.*

- Edition 5 includes for each navigation specification (but A-RNP) (Vol II, Part B and C) the same paragraph :

"Many aircraft have a holding capability: Aircraft can either hold manually over a waypoint when the aircraft holding functionality is not available and the pilot is expected to manually fly the holding pattern, or the navigation system's holding functionality can be used to execute the published hold".

# Airspace concept

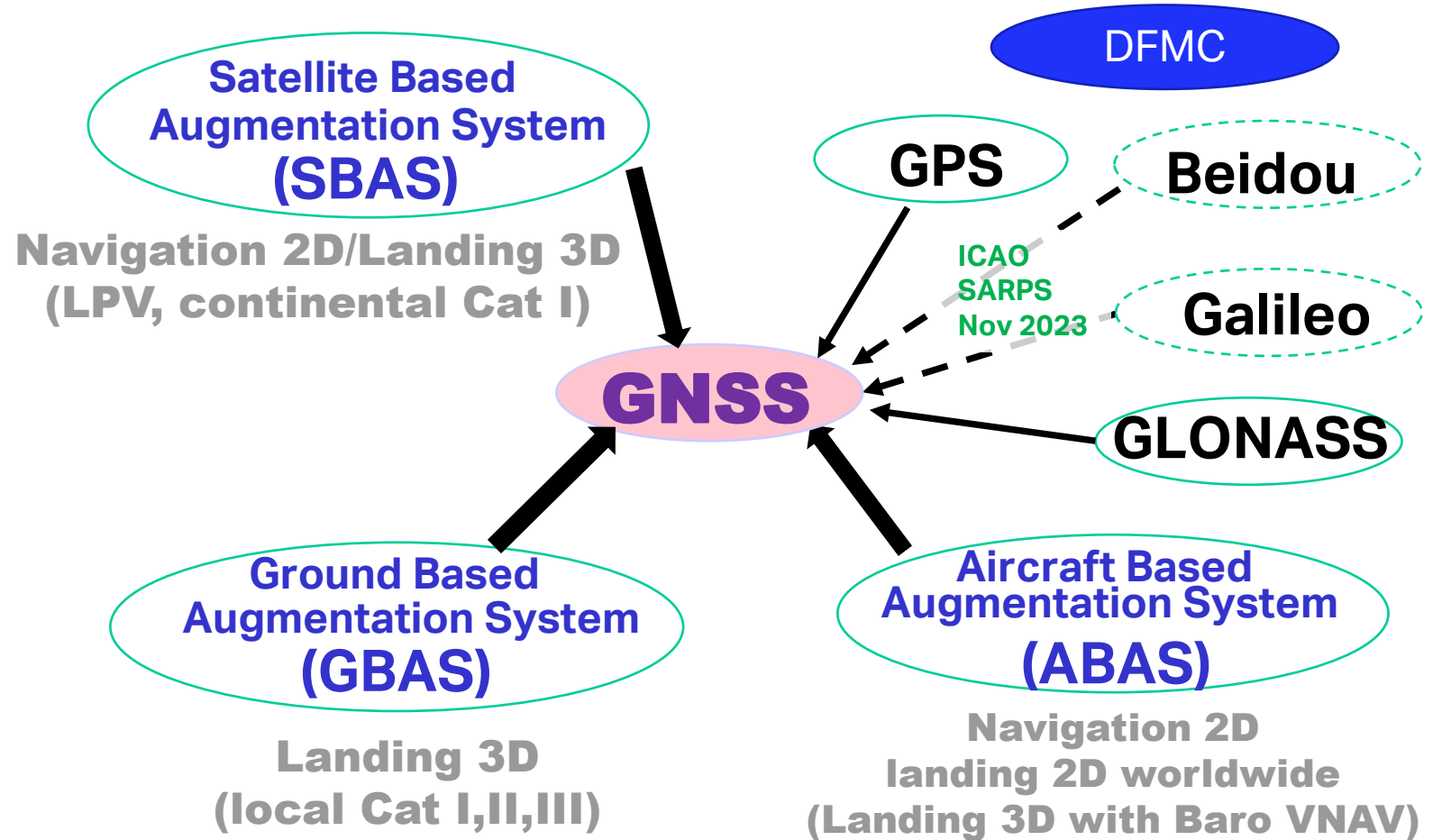
## PBN Manual Edition 5 clarifies :

- The use of PBN as enabler for the free routing as for ATS defined routes
  - **Fully updated Attachment C** (volume II) : "Sample Airspace concepts based on navigation specifications"
- The use of more flexible operating environment for Nav Spec (low high or medium density, with or without ATS surveillance) :
  - **Change from originally intended operating environment**, requires a specific safety assessment to ensure the adequacy of safety requirements in the changed operating environment
- The awareness of information relevant for reversion mode in case of GNSS failure (Vol I and Vol II part B and C).
  - **PBN depends on what reversionary techniques or strategy are available** and what degree of redundancy is required to ensure adequate continuity of functions.



# GNSS and Augmentations

- PBN Manual Edition 5 clarifies :
  - Application of Dual Frequency Multiple Constellation (DFMC) GNSS technologies
  - The use of DFMC SBAS and ABAS to support existing navigation specifications
  - GBAS positioning service will support terminal area navigation specification:
  - GBAS use for final approach is treated similar to ILS and remains within the domain of AWO manual.



# Changes in Vol 2

Geoff Burtenshaw  
Barry Miller  
Dave Nakamura

10 August 2022



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# Advanced RNP (A-RNP) - Background

- Introduced into Doc 9613 Edition 4 in 2013
- Intended to consolidate navigation requirements and simplify the aircraft certification process
- Reflected modern aircraft performance and functionality of the time
- Maximise utilisation of those capabilities, but avoid the need to invoke Special Approvals i.e., RNP AR
- Not well understood how A-RNP fits into an ATM environment and therefore was either not adopted or else, mis-adopted
- At the time, charting of PBN with respect to Navigation Specification did not help

# Changes to A-RNP Edition Five

- Provide further explanation on how to implement A-RNP
  - Appendix included with:
    - Scope and applicability
    - Stakeholder Considerations – States, Operators, Manufacturers
    - Regulator and Equipment Standards
- Remove Final approach Segment from scope of navigation specification
  - Final approach remains as either RNP APCH, RNP AR APCH or xLS
- Make A-RNP a fixed 0.3 NM lateral navigation accuracy in terminal airspace i.e., Arrival Procedures, Initial and Intermediate Approach and Departure Procedures
  - Drops the notion of Scalability, which no-one understood
  - Reflects normal navigation performance in this flight phase
  - Makes the navigation specification more attractive to airspace designers
  - Remains distinct from Specific Approvals required under RNP AR

# Changes in A-RNP Lateral Navigation Accuracy Edition 4 to Edition 5

Navigation specification	Navigation Application, Flight phase & lateral navigation accuracy (NM)							
	ATS or user-defined routeing		Arrival procedures	Approach Procedures				Departure procedures
	En-route oceanic/remote	En-route continental	Arrival	Initial	Intermediate	Final	Missed <sup>1</sup>	Departure
Advanced RNP (A-RNP) Edition 4	2	2 or 1	1	1	1	0.3	1	1
Advanced RNP (A-RNP) Edition 5	2 <sup>3</sup>	2 or 1	0.3	0.3	0.3		1 <sup>9</sup>	0.3

Notes:

1. The area of application is from the start of climb and along missed approach segments (intermediate and final).
3. Optional — requires higher continuity.
9. For missed approach considerations including exceptions for use of lateral navigation accuracy of 0.3 NM, see Vol II, Part C, Chapter 4, 4.2.3.3.



## 4.2.3.3 Missed Approach Considerations

- A-RNP missed approach lateral navigation accuracy is normally 1.0 NM, but States may authorize 0.3 NM on an exceptional basis, subject to a safety assessment including consideration of at least the following items:
  - i. Aircraft eligibility e.g., inertial navigation system
  - ii. Contingency procedures, including extraction considerations
  - iii. ATM Infrastructure including the available C,N and S environment
  - iv. Design of the missed approach path and in particular, the first turn point especially if RF is used
  - v. Publication and charting, including the navigation database
- Study Group concerns that A-RNP did not become a workaround to avoid the more appropriate adoption of RNP AR
- A pathway provided, but subject to safety assessment and possible controls



# Flight Operations Aspects

- A-RNP operational authorisation envisaged to be a similar process to RNP 1 etc.
- It does mean that the operator is good for RNP 2, RNP 1, Initial, Intermediate and Missed Approach segments, and RNAV 5, RNAV 2 and RNAV 1
- A-RNP must be used for applications requiring 0.3 NM lateral navigation accuracy and exclusive A-RNP capabilities e.g., RNP Holding
- A-RNP specification should be specified in the PBN Requirements Box or equivalent notes on the chart - chart will remain titled as RNP – Route, SID, STAR, Transition or APCH
- Reference Material:
  - FAA AC 90-105A (to be superseded by AC 90-119)
  - Commission Regulation (EU) No 965/2012 – Air-OPS, CAT.OP.MPA.126 and CAT.IDE.A.345



# Implementing RNP with Authorization Required (AR)

Feedback from States implementing RNP AR operations, operators, OEMs and regulators led the Study Group to update of the RNP AR nav specs in Volume II, Chapter 6, **IMPLEMENTING RNP AR APCH**

- Study Group members made up a dedicated working group for the effort
- Consensus agreed to the need for a complete update of the **RNP AR** nav specs -- consistent with latest regulatory standards and practices
  - One major, new nav spec: **RNP AR Departure Procedures (RNP AR DP)**, plus
  - Guidance for a **Flight Operational Safety Assessment (FOSA)**
  - The new RNP AR DP nav specs merge with the existing RNP AR APCH nav specs in newly titled Chapter 6:

## **IMPLEMENTING RNP with Authorization Required (AR) (RNP AR APCH and RNP AR DP)**

# RNP AR DP Nav Specs

Harmonize RNP AR Terminology:

**RNP AR Operations**  
**RNP AR APCH and RNP AR DP**  
**RNP APCH Procedures**

# RNP AR DP Nav Specs

- New RNP AR DP nav specs merge the aircraft's takeoff & climb performance with the aircraft's navigation performance
  - Based on experience with Special RNP DPs and RNP AR APCH ops
  - RNP AR DP procedure design limited to RNP 0.30
- Nav specs embrace aircraft type certificate (TC) requirements for takeoff & climb performance – including one engine inoperative (OEI) performance
- Requires the operator to have detailed takeoff & climb performance data, including data for nonstandard climb gradients
  - Some operators will need additional aircraft performance data from the OEM
- Requires planning for loss of an engine – OEI performance
  - Statistically loss of an engine is probable across all phases of flight
  - Operationally, a best practice for every takeoff & departure

# RNP AR DP Nav Specs - continued

- Require the ability to extract the aircraft from an RNP AR DP with OEI
  - Operator shall ensure the aircraft's ability to fly the RNP AR DP's defined procedural path with OEI – mitigation options are available
  - Options based on success of FAA AC 120-91, *Airport Obstacle Analysis*
- RNP AR DP aircraft eligibility requirements to support close-in turns
  - Feedback from the avionics and aircraft OEMs formed the foundation for aircraft eligibility to perform such close-in turns
  - Aircraft take-off phase of flight shall be **complete** before turning on a RNP AR DP – aircraft TC's do NOT support turns in the takeoff phase
  - RNP AR DP procedure design can place RF leg at the runway's end (DER)
  - May need to define the procedural path from the approach end of the runway thru the DER

# RNP AR DP Procedure Design Requirements

- RNP AR DP requires RNP<1.0, RF turn bank angle max of 20 degrees
  - Maximizes the number of aircraft available for RNP AR DP
  - Provides a 5-degree "buffer" of available bank angle
- 210 KIAS limiting airspeed when first turn is close to or at the runway DER
  - "Close in" is when first turn is within 1 NM of the DER
  - Ensures accurate turn anticipation calculations and path compliance
  - Based on ops feedback and experience with special RNP DPs

# RNP AR Procedure Design Requirements

- RNP AR DP procedure design shall consider the normal performance of the aircraft; however,...
- Operators shall develop contingency plans for aircraft performance with OEI
  - Fly the published RNP AR DP with OEI
  - Fly an alternate, tailored DP published in the onboard navigation database
  - Fly a specific, published, approved pilot procedure



# RNP AR Ops & Flight Ops Safety Assessment FOSA

- Offers guidance to States & operators on FOSA methodology – goal to meet the RNP AR Ops safety performance target of  $1 \times 10^{-7}$  or less
  - ***No ICAO guidance for non-public RNP procedures or "Specials"***
  - States may apply FOSA to non-public, "special" RNP procedures that are noncompliant with ICAO Doc 9905 or another State's RNP design criteria
  - States ***may*** choose to exclude noncompliant procedures from their AIP
  - Flow chart helps distinguish RNP AR Public procedures from non-public
- Offers guidance on how to conduct operator evaluation for a FOSA
  - Flow chart offers high-level guidance for the operator's evaluation
  - Focused on RNP AR ops hazards from the operator's perspective

# RNP AR Operations Goal



# Vertical Navigation (VNAV) in Final Approach

- Replaces Attachment A – Barometric VNAV (Baro-VNAV)
- Focuses on VNAV in the FAS supported by an RNP system for PBN ops
  - VNAV supported by an airworthiness approval
  - When the RNP procedure requires VNAV (i.e., LNAV/VNAV line of mins) -- "Approved VNAV" or "VNAV for operational credit"
  - Where procedures do not require VNAV -- "Advisory VNAV"
- VNAV may source from barometric VNAV (Baro-VNAV) or GNSS VNAV
  - Aid to pilots' vertical SA while offering smooth descents & CDFA
- Procedures **requiring** VNAV – ILS, MLS, GLS, RNP APCH (LNAV/VNAV or LPV) and RNP AR APCH
- Procedures **not requiring** VNAV – RNP APCH to LP or LNAV mins
- Guidance on DA/H vs. MDA, along with broad aircraft eligibility guidance



# On-Board Performance Monitoring and Alerting (OBPMA)

## OBPMA Concept

- Fundamentally, **the original concept is unchanged in Edition 5.**

OBPMA is a capability that allows the air crew to determine whether or not the RNP system satisfies the navigation performance required by an RNP navigation specification and application. OBPMA is the assurance of both lateral and longitudinal navigation performance.

- Volume II changes are primarily, extensive clarifications to improve readability and understandability by a less technical audience

# The application of Magnetic Variation

- Up to Edition 4, Magnetic Variation (MagVar) was only identified as a factor for some of the functional capabilities described in the manual.
- Significant in-service problems lead the FAA Performance based operations Aviation Rulemaking Committee, to issue guidance for MagVar.
- The guidance was developed into standards included in the RTCA/EUROCAE MASPS for RNP RNAV Systems, DO-236/ED-75.
- Edition 5 includes the MASPS standards and guidance as a new attachment providing information for States implementing RNP operations where MagVar is an element of routes and procedures stored in the onboard navigation database.



# The application of Magnetic Variation

- MagVar selection and use in avionics equipment e.g. FMS was revised extensively to cover cases of what magnetic variation (e.g. airport, procedure, navaid, station declination, etc) should be used for specific leg types including course to a fix (CF), course from a fix to an altitude (FA) and holding. The inconsistency in this selection in current airplane systems present problems and risks to certain operations and airports.



# Q&A

## Moderator

Ian Knowles

Tomonori Tsuruzono



10 August 2022



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# Q & A

Moderator will pick up the question posted.

Please post your question regarding presented items!



# Question from registration form

## Question :Flight plan code for RNP2 and A-RNP?

( New code for Item /18 – Planned effective in 2024)

RNP2 continental	:	M1*
RNP2 oceanic	:	M2*
RF LEG**	:	Z1*
FRT**	:	Z2
RNP0.3 ( Helicopter)	:	R1
A-RNP	:	P1* (ICAO-plan to be reviewed)

\*) FAA will introduce in 2022

\*\*\*) RF /FRT as independent function and combination with other Nav Spec

# Question from registration form

## Question:

- Will VPT be included in this release ? Or will it be released separately?

## Answer:

- RNP (VPT) (formerly referred to as RNAV Visuals) is subject of a separate ICAO Circular.
- Final draft currently in coordination with ICAO panels.

# Question from registration form

## Question:

- Are there any regions that have introduced the A-RNP approval process?
- Does an airline have to certify for A-RNP, if yes, how?

## Answer:

- Yes, see slide 26.
- An operational authorization is required, just like any other PBN specification.
- It depends on the State Approval process, but it could be an OM authorization based on pre-existing specifications and assessment of functional differences.
- *Note: OEM documentation today references A-RNP e.g., Boeing RNP Capability Document*
- *Note: RNP AR requires a Specific Approval*

# Question from registration form

## Question:

- For UPR Operation, What's PBN Specification for DCT segment in North America and Europe FRA?

## Answer:

In EUR Free Route Airspace (FRA) and Direct Routing (DCT) there is no specific PBN requirement, although aircraft are required to have an area navigation capability and operate between defined points.

The airspace is typically managed with a minimum radar separation of 5 NM and therefore RNAV 5 would be an implicit requirement. However, most FMS will default to +/- 2 NM during this flight phase and therefore RNP 2 may be considered as more appropriate.

# Question from registration form

## Question:

Is RNP0.3 required or optional for PinS? There is no guidance in the manual on PinS, will this be included in the future?

## Answer:

The RNP 0.3 Nav Spec does not address the RNP APCH FAS. Existing PinS procedures need not embrace RNP 0.3 nav specs. However, RNP 0.3 nav spec can support transition to a PinS procedure.

# Question from registration form

## Question(RNP-AR):

- Is an individual authorization necessary for each airport or one authorization? ( RNP-AR)
- What change ( Approval process) with new edition in RNP DP procedure already published?

# Thank you



# Back up slides



# Table II-A-1-1

**Table II-A-1-1. Navigation specification, Flight phase, navigation applications, and associated lateral navigation accuracies (NM)**

Part Chapter	Navigation specification	Navigation Application, Flight phase & lateral navigation accuracy (NM)							
		ATS or user-defined routeing		Arrival procedures	Approach Procedures				Departure procedures
		$E_{\text{N}}$ -route oceanic/remote	$E_{\text{N}}$ -route continental	Arrival	Initial	Intermediate	Final	Missed <sup>1</sup>	Departure
B, Ch.1	RNAV 10	10							
B, Ch.2	RNAV 5 <sup>2</sup>		5	5					
B, Ch.3	RNAV 2		2	2					2
B, Ch.3	RNAV 1		1	1	1	1		1	1
C, Ch.1	RNP 4	4							
C, Ch.2	RNP 2	2 <sup>3</sup>	2						
C, Ch.3	RNP 1 <sup>7</sup>			1	1	1		1	1
C, Ch.4	Advanced RNP (A-RNP)	2 <sup>3</sup>	2 or 1	0.3	0.3	0.3		1	0.3
C, Ch.5	RNP APCH <sup>4</sup>				1	1	0.3 <sup>5</sup>	1 <sup>8</sup>	
C, Ch.6	RNP AR				1-0.1	1-0.1	0.3- 0.1	1-0.1	1-0.3
C, Ch.7	RNP 0.3 <sup>6</sup>		0.3	0.3	0.3	0.3		0.3	0.3

Notes:

1. The area of application is from the start of climb and along missed approach segments (intermediate and final)
2. RNAV 5 is an en-route navigation specification which may be used for the initial part of an arrival procedure outside

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# Table II-A-1-2

Table II-A-1-2: Example of airspace requirements and corresponding RNP System functions

Operational (Airspace) Requirement	Enabling RNP System Function with permitted Navigation Specification	
<p>a. Enabling operations on closely spaced/parallel routes with consistent and repeatable turns on SIDs/STARs.</p> <p>b. Enabling curved approaches, particularly through terrain rich areas but also to support environmental mitigation.</p>	<p>a. Radius to Fix (RF) can be used on SIDs/STARs, with the following specifications: RNP 1, Advanced RNP, RNP 0.3 (for helicopters), RNP AR DP.</p> <p>b. Radius to Fix (RF) can be used outside the final approach, with the following specifications: RNP 1, Advanced RNP, RNP 0.3 (for helicopters) and RNP APCH and RNP AR. <i>Note: If there is a need to use the RF function inside the final approach segment, there is a mandatory requirement for the RNP AR APCH specification.</i></p>	
<p>c. Maintaining same spacing between ATS routes (excluding SIDs/STARs) on straight and curved segments without a need to increase route spacing on the turn.</p>	<p>c. Fixed Radius Transition (FRT) can be used on ATS Routes and associated with RNP 4, RNP 2 and Advanced RNP;</p>	
<p>d. Flying off-set from the user defined or ATS route, e.g. as an alternative to vectoring;</p>	<p>d. Parallel Offset function can be applied 'tactically' (e.g. on instruction from ATC) or strategically. The function can only be used on user-defined routes and on ATS routes that are not SIDs/STARs. The Tactical application is commonly referred to as Tactical Parallel Offset and the offsets used are typically in increments of 1NM, e.g. 5NM offset. The Strategic Parallel Offset function are included in the architecture of the airspace concept. The Parallel Offset Function can be associated with RNP 4, RNP 2, Advanced RNP.</p>	

*Note: ANSPs may include holding procedures in their airspace design using a waypoint as holding point. Aircraft can either hold manually over a waypoint when the aircraft holding function is not available and the pilot is expected to manually fly the holding pattern, or the navigation system's holding function can be used to execute the published hold.*

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# Table II-A-1-3

Table II-A-1-3 Navigation Specifications and RNP System Functions

Part Chapter	Navigation Specification	Additional Functionalities (Required or Optional)				
		RF	FRT <sup>3</sup>	VNAV (Final segment)	Parallel Offset <sup>4</sup>	TOAC
		Vol II, Appendix 1 to Part C	Vol II, Appendix 2 to Part C	Vol I, Att. A	Vol II, Att. A	Vol II, Appendix 3 to Part C
B, Ch.1	RNAV 10	N/A	N/A	N/A	N/A	
B, Ch.2	RNAV 5	N/A	N/A	N/A	N/A	
B, Ch.3	RNAV 2	N/A	N/A	N/A	N/A	
B, Ch.3	RNAV 1	N/A	N/A	N/A	N/A	
C, Ch.1	RNP 4	N/A	O	N/A	R	
C, Ch.2	RNP 2	N/A	O	N/A	O	
C, Ch.3	RNP 1	O <sup>1</sup>	O	N/A	N/A	
C, Ch.4	Advanced RNP	R <sup>1</sup>	O	N/A	R	
C, Ch.5	RNP APCH	O <sup>1</sup>	N/A	O (Baro or SBAS)	N/A	
C, Ch.6	RNP AR	R <sup>2</sup>	N/A	R <sup>5</sup> (Baro or SBAS)	N/A	
C, Ch.7	RNP 0.3	O <sup>1</sup>	N/A	N/A	N/A	

Notes:

- RF can be only used for arrival, departure and instrument approach procedures excluding the final segment.
- RF can be used with any segment of RNP AR APCH, or for RNP AR DP.
- FRT can only be used for RNP ATS routes, excluding departures and arrivals.
- The parallel offset function may be used for user-defined routes, ATS routes, excluding arrivals and departures. This is an available in-service capability within some aircraft and systems that perform RNAV and RNP applications. No functional requirements exist except for RNP 4 and Advanced RNP. Lacking a standard for aircraft and system, general use of the parallel offset capability is at the discretion of the operator and their operating procedures. The parallel offset function identified within A-RNP is specified in accordance with DO-236(J/ED-75()) and provides a basis for the specification of airspace and ATS routes.
- VNAV is only a requirement for RNP AR APCH and not for RNP AR DP. Attachment A to this Volume provides general information on VNAV.

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# Table II-A-1-4

Table II-A-1-4: Navigation Specifications and (Required or Optional) NAVAID infrastructure

	GNSS	GNSS/Inertial navigation system	DME/DME	DME/DME/ Inertial <sup>3</sup>	VOR/DME
RNAV 10 <sup>1</sup>	O	O			
RNAV 5 <sup>1</sup>	O	O	O	O	O
RNAV 2 <sup>1</sup> & 1 <sup>1</sup>	O		O	O	
RNP 4	R				
RNP 2	R		O <sup>2</sup>	O <sup>2</sup>	
RNP 1	R		O <sup>2</sup>	O <sup>2</sup>	
ADVANCED RNP	R		O <sup>2</sup>	O <sup>2</sup>	
RNP APCH	R				
RNP AR	R	R			
RNP 0.3	R				

Notes:

1: For these navigation specifications where there is a choice of navigation infrastructure/positioning sources, at least one NAVAID is required for the promulgated associated navigation application.

2: The use of DME/DME for this navigation specification requires a specific State authorization

3: Inertial sensors may be integrated with the GNSS or DME/DME sensor to improve performance and continuity of the operation.

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