April 23, 2015

Ms. Peggy Gilligan
Associate Administrator for Aviation Safety
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591

Dear Peggy:

The Performance-based Operations Aviation Rulemaking Committee (PARC) is pleased to submit the attached recommendations of the Performance Based Navigation (PBN) Procedure Naming and Charting Action Team in the attached report. These recommendations are a follow on to recommendations made on 27 September 2011. The focus on this subsequent recommendation is to allow for the continued evolution of charting, focusing on performance based procedures and also to address the recent International Civil Aviation Organization (ICAO) guidance on promulgation of PBN procedures.

The Action Team consisted of 66 Subject Matter Experts (SMEs) covering avionics, aeronautical databases, air traffic (ATC), aeronautical information services (AIS), charting, flight operations, aircraft and avionics certification, and original equipment manufacturers (OEMs).

In summary, the Action Team and PARC recommendations to the FAA are:

1. That at all PBN Approach procedure titles: begin with 'RNAV'; contain a suffix used to differentiate when there is more than one RNAV procedure to the same runway end; and contain the runway/course (for helicopter procedures) number/letter designator when required and that the transitions in procedures are based on only a single Navigation Specification (Nav Spec).
2. That all PBN Departure Procedure (DP) and Standard Terminal Arrival Route (STAR) procedure titles: include 'RNAV' in parentheses; and, that all transitions in a procedure are based on the same Navigation Specification.
3. That all PBN procedures (Approach, DP and STAR) contain a PBN Requirements 'Box'. The 'Box' will contain PBN-related information.

The PARC would like to acknowledge and thank the Action Team, led by Pedro Rivas and Mike Webb. These proposals were the result of a consensus agreement that addressed the various stakeholders' concerns, objectives and limitations.

The PARC appreciates your continued support of our activities and invites you to join us in a discussion of these recommendations at your convenience. Please let me know if you have any questions or would like to set up a discussion. We look forward to your response.

Sincerely,

Mark Bradley
Chairman
Performance-based Operations
Aviation Rulemaking Committee

Cc: B. DeCleene
M. Webb
P. Rivas

PARC PBN Procedure Naming and Charting
Action Team Report

April 15, 2015

## 1. BACKGROUND

The Performance-based Operations Aviation Rulemaking Committee (PARC) established a Performance Based Navigation (PBN) Procedure Naming and Charting Action Team (AT) to address the issue of naming and charting conventions for PBN procedures. The Terms of Reference, established by the PARC for the AT, stated that the current procedure naming and charting convention does not adequately communicate the performance and functional requirements of PBN procedures or address recent ICAO guidance for PBN procedure charting and that an updated convention to address this should be developed. The expected deliverables from the AT were:

- A procedure naming convention for PBN Departure Procedures (DPs), Standard Terminal Arrival Routes (STAR) s and hybrid (PBN-Conventional) Approaches
- Recommendations on the information requirements associated with PBN and hybrid PBN procedures, i.e., additional information that should be communicated to the user but is not conveyed in the procedure title
- A summary report providing the rationale and reasons behind the AT's recommendations

We believe this AT Final Report meets the expected deliverables.

## 2. EXECUTIVE SUMMARY

The PARC PBN Naming and Charting AT had one meeting in Rosslyn, VA in October 2013 and internet based meetings in December 2013, February, April, October and November 2014. The AT was comprised of 66 Subject Matter Experts, who represented Database, Avionics, and Charting, Aeronautical Information Service, Air Traffic, Flight Ops and Certification communities. The AT proposals are a result of consensus agreements.

PROPOSAL: It is recommended that all PBN approach procedure titles: begin with "RNAV"; contain a suffix used to differentiate when there is more than one RNAV procedure to the same runway end; contain the runway/course and number/letter; and include parentheses harmonized with ICAO Procedures for Air Navigation Services– Aircraft Operations (PANS OPS) recommendations (Amendment 6 to Vol II, 5th Edition) when there is no RNP Approach (RNP APCH) navigation specification (Nav Spec) Lateral Navigation (LNAV) line of minima on the procedure.

PROPOSAL: It is recommended that all PBN DPs and STAR procedure titles: include 'RNAV' in parentheses in the title of the procedure (as they currently do) and that all the transitions in the procedure be based on the same Nav Spec (RNP 1, RNAV 1, etc.)

PROPOSAL: It is recommended that all PBN procedures (Approach, DP and STAR) contain a PBN Requirements Box. The Box should contain PBN-related information, to include the Nav Spec, supporting sensors and specific advanced functionality not mandatory within the Nav Spec (e.g. RF legs for an RNP APCH) required for a common segment of a procedure.

PROPOSAL: It is recommended that all hybrid instrument approach procedures (i.e. IAPs with one or more PBN segments(s) to a conventional final approach segment should contain a PBN Requirements 'Box'. The PBN Requirements 'Box' should contain PBN-related information, to include the Nav Spec, required supporting sensors and specific advanced functionality

PROPOSAL: It is recommended that only a single Nav Spec be specified for the terminal routes on each PBN or hybrid (PBN-conventional) procedure.

3. Overview

The U.S. is developing detailed PBN naming and charting conventions and the PARC PBN Naming and Charting AT assessed the various options and formats. The ICAO Procedures for Air Navigation Services– Aircraft Operations (PANS OPS) Amendment 6 contains ICAO guidance on PBN charting. However, in several areas the ICAO guidance lacks the detail necessary for a full charting implementation. Unless otherwise noted the guidance in this paper is either in harmony with the ICAO guidance or covers additional details not addressed by ICAO.

4. Procedure Chart Title – Instrument Approach Procedures

Background

Procedure titles can be divided into four separate elements (See Table 1). The first element defines the system used for lateral guidance in the final approach segment e.g. VOR, NDB, MLS, ILS or LOC, RNAV, etc.

The second element of the procedure name element is the suffix. It consists of an alphabet letter e.g. A, X, Z, etc. and is used to indicate when there is a duplicate (or a circling) procedure to the same runway, airport or location.

The third is the runway/course designator (and this is used when the IAP is not a circling approach) e.g. Rwy 14, Rwy 18C, CRS 330 etc.

The fourth element only exists in RNAV procedures and is enclosed in parenthesis. This element is also referred to as the "parenthetical". This element will indicate the limitation on the available lines of minima when an RNP APCH LNAV line of minima is not available on the procedure.

| **Title** | **Suffix** | **Runway Designator** | **Parentheses** |
|---|---|---|---|
| **RNAV** | **Y** | **RWY 31** | |
| **RNAV** | **Y** | **RWY 31** | **(AR)** |
| **RNAV** | **Y** | **RWY 31** | **(LPV Only)** |
| **RNAV** | **Y** | **RWY 31** | **(LPV and LNAV/VNAV Only)** |
| **ILS (or GLS)** | **Y** | **RWY 31** | |

Table 1- Examples of PBN and PBN-Conventional Procedure Titles

Recommendation #1: Retain "RNAV" as the procedure name in the title for any procedure whose final approach segment is based on PBN navigation.

The current PARC Action Team, herein and after referred to as the AT, reaffirmed the recommendations from the previous 2011 PARC AT for procedure naming and the chart title. The 2011 PARC AT found that there was insufficient benefit to changing the PBN Instrument Approach Procedure (IAP) prefix from RNAV to RNP to warrant the associated changes that would be required in avionics, pilot training, air traffic terminology, database standards, policy guidance, etc. (Refer to 2011 PARC Procedure Naming AT Report for detailed rationale and explanation of the recommendation attached).

The FAA should further engage ICAO regarding this issue and file a difference if required to the current ICAO standard of "RNP" in the title.

IAP Suffix

The issue of whether the IAP suffix should include a specific attribute for the PBN procedure was evaluated. Because of the relatively large number of suffixes it was unlikely to result in high levels of pilot recognition or understanding of the suffix's associated attribute. Further, as procedures are amended over the years, it would become very difficult to manage changing the suffix for all the procedures as changes were made to one procedure. It was determined that no change to the current standard for implementation of procedure suffixes was required.

Procedure Title Parentheses - IAPs

The AT recommended using parentheses to denote unique requirements for the final segment of the approach, over and above the most basic LNAV capability that is described in the RNP APCH Nav Spec. See Table 2. This is consistent with the ICAO guidance in PANS OPS Amendment 6 on the use of the parentheses.

| FAS Navigation Specification & Condition | Parentheses | Example |
|---|---|---|
| RNP APCH & Procedure has LNAV Line of minima | None | RNAV RWY 23 |
| RNP APCH & Procedure has only an LPV line of minima | LPV only | RNAV RWY 23 (LPV only) |
| RNP APCH & Procedure has only an LNAV/VNAV line of minima | LNAV/VNAV only | RNAV RWY 23 (LNAV/VNAV only) |
| RNP APCH & Procedure has both LPV and LNAV/VNAV lines of minima but no LNAV minima | LPV, LNAV/VNAV only | RNAV RWY 23 (LPV, LNAV/VNAV only) |
| RNP APCH & Procedure has only an LP line of minima | LP only | RNAV RWY 23 (LP only) |
| RNP AR APCH Nav Spec | AR | RNAV RWY 23 (AR) |

Table 2

Recommendation #2: The AT recommends that the location of the parentheses should be at the end of the procedure title. This is consistent with the ICAO guidance in PANS OPS Amendment 6 for parentheses placement for IAPS.

Recommendation #3: The AT recommends that procedures with an LNAV line of minima will not require a parenthesis in the chart title. Procedures without an LNAV line of minima will be assigned parentheses as indicated in Table 2. This is consistent with the ICAO guidance in PANS OPS Amendment 6 for parentheses application for IAPS."

Recommendation #4: Use (AR) in the parentheses for RNP AR APCH approaches.

Even though the convention is not to include the Nav Spec in the parentheses this exception to the general rule maintains harmony with ICAO guidance in PANS OPS Amendment 6 and ensures the pilot is alerted in the procedure title that Authorization Required (AR) applies to the procedure.

**Procedure Chart Title – Departures and Arrivals**

The AT is recommending not following the ICAO guidance in PANS OPS Amendment 6 which states: "The chart shall be identified in accordance with Annex 4, 9.5 for departures and 10.5 for arrivals and shall include the term RNAV or RNP, depending on the navigation specification". The ICAO guidance in PANS OPS Amendment 6 does not stipulate whether the Nav Spec should be in procedure title.

Recommendation #5: For ease of implementation and consistency with the naming of PBN IAPs, it is recommended that all PBN Departure Procedure (DP) and Standard Terminal Arrival (STAR) procedure titles: include 'RNAV' in parentheses in the title of the procedure and that the PBN transitions in the procedure be based on only a single Nav Spec (RNP 1, RNAV 1, etc.) which will be identified in the PBN Requirements Box.

**PBN Requirements Box Information**

Background & Overview: The ICAO guidance specified "PBN items shall be separated out and published in a PBN Requirements Box ..." This guidance is consistent with the 2011 PARC Procedure Naming Action Team Report which stated: "It is recommended that all PBN procedures (Approach, DP and STAR) contain a PBN information 'box'. The 'box' would contain PBN-related information, e.g., supporting sensors, specific functionality not mandatory within the Navigation Specification..."

Recommendation #6: The PBN Requirements Box should be provided anytime there is a PBN segment in the procedure, including hybrid procedures e.g., an RNAV terminal route to an ILS, ILS to an RNP missed approach, etc. Additionally, the PBN Requirements Box should be separated and easily distinguished from other procedural and non- procedural notes and information on the chart.

The elements of the 'PBN Requirements Box' consist of:

a) Its location
b) Its content and the sequence of that content
c) Recommended abbreviations and/or acronyms

Location of the PBN Requirements Box

The ICAO guidance stated the PBN Requirements Box should be "... published in a PBN Requirements Box on the plan view of the chart immediately below the chart identifier." The AT identified several problems with the ICAO recommendation for location of the PBN Requirements Box. The primary concerns were the lack of consistency of location and covering up potentially important information in the plan view.

Recommendation #7: IAPs: The PBN Requirements Box should not be located in the Plan View but should have a consistent location on the chart to enable the pilot to quickly locate the material and incorporate it in the approach briefing. See Figure 1

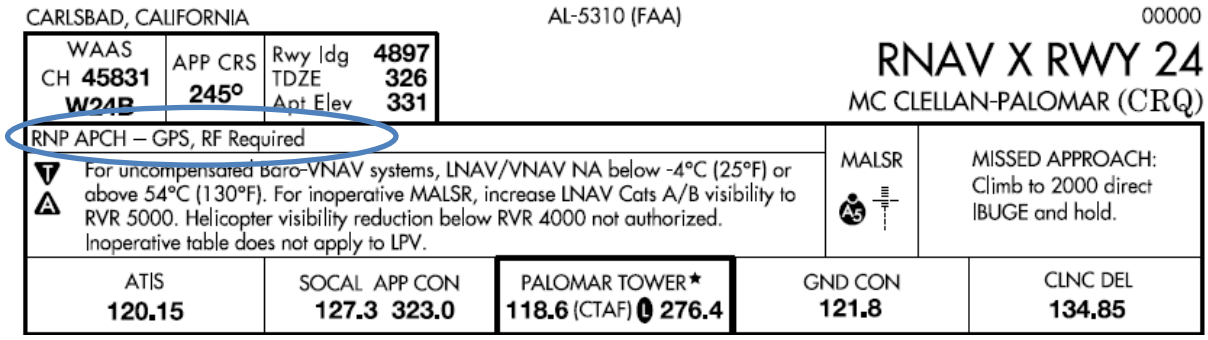


Figure 1

PBN IAP Procedure Title and PBN Requirements Box

Recommendation #8: Departures and Arrivals: The PBN Requirements Box should be in a consistent location (e.g. Top Right or Top Middle) but not a floating note. See Figure 2.

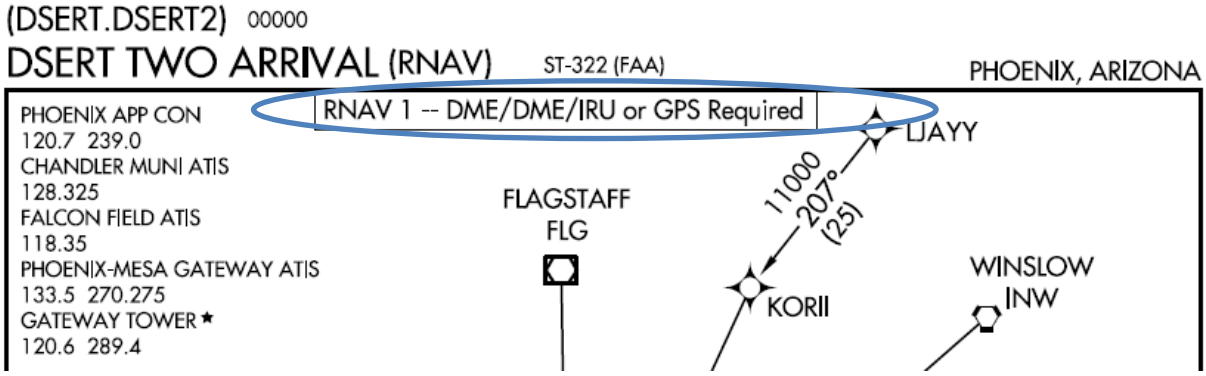


Figure 2

DP and STAR Procedure Title and PBN Requirements Box

Content and sequence of elements in the PBN Requirements Box

The ICAO guidance stated "The PBN Requirements Box shall include the identification of the navigation specification (Nav Spec) used in the procedure design, any navigation sensor limitations and any required functionalities that are described as options in the navigation specification, that is, not included in the core navigation specification..." This guidance is also consistent with the 2011 PARC Report recommendations.

Recommendation #9: The sequence of elements in the PBN Requirements Box should be consistent to facilitate training and understanding. The sequence should be: Nav Spec, Sensor (if a specific sensor is required), and additional functional requirements (not included in the Nav Spec) e.g. RF if not included in the requirements of the Nav Spec. If this standard sequence is used, headings for the PBN Requirements Box are not needed.

NOTE: *A Functional Requirement will only be annotated if it is an optional functional requirement for that Nav Spec.*

Labels, Abbreviations, Acronyms – PBN Requirements Box

PBN Requirements Box Label

Recommendation #10: The PBN Requirements Box does not require a title. (Refer to Figure 1 and Figure 3)

NOTE: In the example depicted in Figure 1and in Figure 3 an em dash (--) is recommended to separate the Nav Spec element from the sensor. A comma (,) is used to separate the sensor from any functional requirement. From a human factors standpoint this will make the PBN Requirements Box easier to understand by separating the Nav Spec from the required functions.

| RNP APCH - GPS, RF Required |
|---|

Figure 3

PBN Requirements Box Acronyms – 1st element: Nav Spec

Recommendation #11: Table 3 contains those acronyms which will be used to represent Nav Specs.

| Item | Acronym or Abbreviation | Notes |
|---|---|---|
| Acronym to be used for Nav Specs with a single numeric accuracy value | RNP or RNAV acronym followed by a space followed by the accuracy value e.g. RNAV 2, RNP 1, RNP 0.3. | This includes the "RNP 0.3" Nav Spec. The "RNP 0.3"Nav Spec only appears in the PBN Requirements Box for IAPs titled "COPTER" (because in the U.S. this *Nav Spec* is associated exclusively with helicopter operations). |
| Acronym or name to be used for Nav Specs with no single numeric accuracy value | RNP APCH | Acronym for RNP Approach Nav Spec |
| Acronym or name to be used for Nav Specs with no single numeric accuracy value | RNP AR APCH | Acronym for RNP Approval Required Approach Nav Spec |
| Acronym or name to be used for Nav Specs with no single numeric accuracy value | A-RNP | Acronym for Advance RNP Nav Spec |

Table 3

PBN Requirements Box Acronyms

Sensor Requirement Rules – PBN Requirements Box

Background: The PBN concept is sensor independent. In principle, any sensor may be used provided it yields the required performance. The PBN Manual (ICAO Doc 9613) Executive Summary, paragraph 4 states: "The PBN concept represents a shift from sensor-based to performance-based navigation. Performance requirements are identified in Nav Specs, which also identify the choice of navigation sensors and equipment that may be used to meet the performance requirements." Thus, the absence of any published sensor requirement indicates that any sensor or sensor combination compatible with the Nav Spec is permitted. However, ICAO Doc 9613, paragraph A 5.1.2.1, 2nd note, states "*Where authorized by the State, the multi-sensor systems may use other sensor combinations such as DME/DME or DME/DME/IRU that provide the navigation performance acceptable for RNP APCH*". Finally, the PBN Manual recognizes that there may be situations where the Air Navigation Service Provider (ANSP) may need to know or restrict the sensor type in use. ICAO Doc 9613, Para 3.1.4 states: "For example, particularly in a mixed aircraft equipage environment, controllers may need to know what navigation sensor an aircraft is using (i.e. RNAV 1 specification can have GNSS, DME/DME/IRU and/or DME/DME) on an ATS route, procedure or airspace, to understand the effect that a NAVAID outage can have on operations."

The PANS OPS Amendment 6 text states that "any navigation sensor limitations" shall be included in the PBN Requirements Box and provides one example "GNSS required". Currently U.S. RNAV (GPS) charts also include a notation to a prohibited sensor, namely "DME/DME RNP-0.3 NA". The AT determined that because the PBN Requirements Box depicts any required sensor, the "DME/DME RNP-03 NA" reference could be deleted.

Recommendation #12: Delete "DME/DME RNP 0.3 NA" note from RNAV IAPs.

Recommendation #13: The following PBN Requirements Box rules for sensor depiction are to be applied:

1. The absence of any sensor requirement in the PBN Requirements Box indicates that any approved sensor compatible with the Nav Spec is approved

2. The PBN Requirements Box sensor depiction will indicate a requirement for a sensor by the FAA, prohibited sensors will not be indicated. (This is in harmony with the ICAO PBN Manual A 5.1.2.1 and avoids the evolution of a laundry list of prohibited sensors in the PBN Requirements Box).

NOTE: It is anticipated that all PBN IAPs will indicate "GPS required". It is envisaged that currently the PBN Requirements Box for U.S. DPs and STARs will depict one of the two following sensor requirement notes:

a) DME/DME/IRU or GPS required, or
b) GPS required

It is understood that the FAA plans to retain the 'GPS' acronym pending the fielding and FAA approval of other ICAO compliant Global Navigation Satellite Systems (GNSS). The use of the 'GPS' acronym will indicate that only the U.S. Global Position System (GPS) is approved for use as a signal/sensor. If and/or when another signal/sensor is approved it may be added to the PBN Requirements Box e.g. "GPS or GALILEO".

The use of the acronym "GNSS" in the sensor requirement location shall indicate that any GNSS system approved by the FAA is permitted.

Recommendation #14: The FAA should continue to use the "GPS" as the required satellite navigation system in the sensor requirement location of the PBN Requirements Box until or unless another GNSS sensor is approved by the FAA.

**PBN Requirements Box Acronyms – 3rd element: Functional Requirement Acronym**

Recommendation #15: Table 4 contains the recommended acronyms for any required additional functions for terminal procedures.

| Functionality | Acronym |
|---|---|
| Radius to Fix | RF |
| Parallel Offset | No Acronym use full text if identified |
| Time of Arrival Control | TOAC |

Table 4

Recommendation #16: Include required functionalities *for the procedure* only if they are described as options in the applicable Nav Spec.

Include required functionalities for the procedure only if they are not incorporated in the core Nav Spec. An optional functionality is only depicted in the PBN Requirements Box when it is required to fly the procedure i.e. a common segment (intermediate/final/missed) requires the functionality or when all transitions require the functionality. See Figure 1.

NOTE 1: The RF should not be depicted when the specified Nav Spec is A-RNP or RNP AR APCH[1].

([1]Assumes FAA incorporates RF as a required functionality for RNP AR APCH approvals)

NOTE 2: The RF, scalability and parallel offset functionalities should not be depicted when the specified Nav Spec is A-RNP. The RF and scalability should not be depicted when the specified Nav Spec is RNP AR APCH. (This is contingent upon the FAA incorporating RF and scalability as a required functionality for RNP AR APCH).

**Approach Transitions – Depicting Optional Functional Requirements**

Recommendation #17: When the optional functionality is only required for one of several terminal routes the PBN Requirements Box will not be annotated with the optional functionality or identify it with the transition. However, the optional functionality will be identified in the Plan View next to the applicable segment(s). This is consistent with the current charting convention for RNP AR APCH procedures. (Refer to Figure 4)

Note that in Figure 4 the "RF REQD" attribute is annotated next to the OCN transition but not the ICUGA transition.

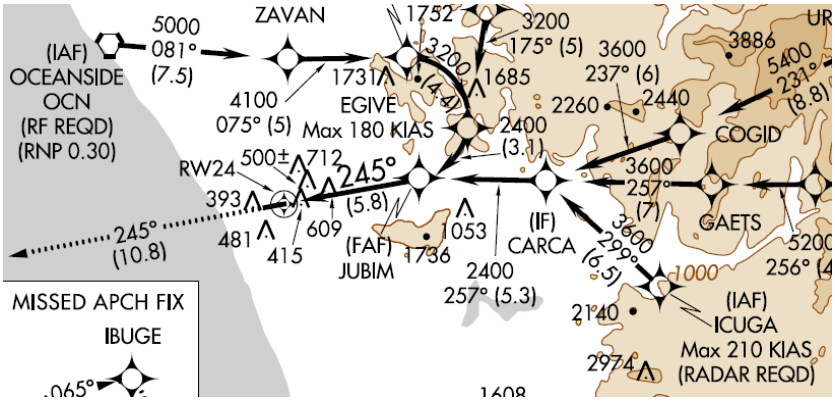


Figure 4

Different optional functions required for different transitions.

**FAA planned depiction of PBN Requirements Box requisites**

Based on feedback from the FAA the AT made the following assumptions:

a) The FAA implementation of the Advanced RNP (A-RNP) Nav Spec will require RF, parallel offset and scalability[1] as mandatory functionalities for the Nav Spec).
b) The FAA will require RF functionality for RNP AR APCH approvals
c) That FAA does not implement or require scalability[1] in Approach Nav Specs other than A-RNP and RNP AR APCH (i.e. RF becomes the *only* functionality depicted on IAPs (when applicable) for those Nav Specs where it is optional i.e. RNP APCH and RNP 0.3).

Table 5 shows the four different PBN Requirements Box depictions that are envisaged for PBN IAPs with and without RF legs:

| Procedure | RF not required for procedure | RF required for procedure |
|---|---|---|
| 1 | RNP APCH - GPS required | RNP APCH - GPS, RF required |
| 2 | RNP 0.3 - GPS required | RNP 0.3 - GPS, RF required |
| 3 | RNP AR APCH - GPS required | |
| 4 | A-RNP - GPS required | |

Table 5

IAP PBN Box depictions

NOTE: A-RNP and RNP AR APCH include mandatory RF and scalability functionality. For other Nav

Specs RF is optional and scalability is not applicable.

Table 6 shows the six different PBN Requirements Box depictions that are suggested for PBN DPs and STARs, with and without RF legs and scalability[1]:

| | **RF not required for procedure** | **RF required for procedure** | **Scalability[1] required for procedure** |
|---|---|---|---|
| 1 | RNAV 1 | *N/A – RF not allowed for RNAV 1* | *NA[@]* |
| 2 | RNAV 1 - GPS required | *N/A – RF not allowed for RNAV 1* | *NA[@]* |
| 3 | RNAV 1 – GPS or DME/DME/IRU required | N/A – RF not allowed for RNAV 1 | *NA[@]* |
| 4 | RNP 1 | RNP 1 - RF required | *NA[@]* |
| 5 | RNP 1 - GPS required | RNP 1 - GPS, RF required | *NA[@]* |
| 6 | RNP 0.3 - GPS required | RNP 0.3 - GPS, RF required | *NA[@]* |
| 7 | A-RNP - GPS required | | |

Table 6 – PBN Requirements Box depiction for DPs and STARs

*NA[@]* –By definition scalability is incompatible with a fixed accuracy value RNP or RNAV Nav Spec. Scalability requires functionality over a range of RNP values.

[1]Scalability - Definition: The RNP system must be capable of manual or automatic entry and display of navigation accuracy requirements in tenths of a nautical mile (NM) between 0.3 and 1.0 NM.

NOTE: Table 6 assumptions:

1. Current RNAV 1 DPs and STARs will continue in the NAS. The PBN Requirements Box will indicate whether GPS is required or not
2. RNP 2 and RNAV 2 procedures are not included in Table 4 for brevity because the FAA currently does not require this performance value (Nav Spec) for DPs or STARs.
3. RNP AR DP or STAR not included because criteria does not exist at this time and there is no short/medium term plan to implement public RNP AR departures or arrivals.

Recommendation #18: The "scalability" function should not be depicted in the PBN Requirements Box for PBN DPs and STARs as it is not an acceptable option with any Nav Spec used in DPs and STARs other than Advanced RNP, where it is a mandatory capability.

NOTE: The AT recognized that including the "scalability" option on charts (in the PBN Requirements Box) would require FAA Aeronautical Information Manual (AIM) text and additional ATC and pilot training and understanding. (Pilots would need to have some understanding of the meaning of "scalability" to determine whether the aircraft was compliant.) Additionally, the flight planning system would have to accommodate this attribute identifier to enable the Air Navigation Service Provider (ANSP) system to determine whether an aircraft is capable of being assigned a procedure requiring scalability. To avoid these additional complexities and recognizing that the function was limited to the A-RNP and RNP AR APCH Nav Spec, where it is mandatory, the AT determined that including "scalability" in the PBN Requirements Box was neither necessary nor prudent.

**Hybrid Procedures**

A hybrid procedure is one that contains one or more PBN terminal routes (in the case of IAPs) or transitions (in the case of DPs and STARs) and contains a conventional common segment e.g. ILS Final Segment.

Recommendation #19: The procedure title for the hybrid procedures should continue the current convention of naming the procedure based on the equipage requirement for the Final Approach Segment.

It was determined that changing this convention was neither needed nor wise and that any change would have repercussions on conventional procedure title naming.

RNP AR Banner

Recommendation #20: Retain chart note "AUTHORIZATION REQUIRED" to be consistent with the existing charting of RNP AR APCH procedures. (Refer to Figure 3 for example)


Figure 5