Performance Based Navigation (PBN) Clarification Ad Hoc Team

NAC Task 19-4 Report

To be Presented to the NextGen Advisory Committee

November 2020

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Executive Summary

In December 2019, the NextGen Advisory Committee received a tasking to provide the FAA (Federal Aviation Administration) with an assessment of a PBN (Performance Based Navigation) baseline, a definition of a PBN NAS (National Airspace System), and the identification of specific PBN desired outcomes at the Core 30 airports (minus HNL, plus TEB).

The PBN Ad Hoc Team's report provides details on PBN baseline capabilities consistent with the equipage outlined in the NextGen Minimum Capabilities List (MCL) and continues to endorse the 2016 PBN National Airspace System Navigation Strategy as the definition of a PBN NAS. The desired PBN outcomes are presented as a set of 48 prioritized PBN proposals. These proposals can serve as the fundamentals needed to achieve the objectives, address requirements, and meet expectations of the NAS NAV Strategy. More immediately, these priorities can be used to refresh the PBN production process and help the FAA move forward on the backlog of procedure requests in the Instrument Flight Procedures (IFP) Gateway.

The PBN Ad Hoc Team wishes to thank the FAA for this tasking and believes that this coordinated effort will provide a pathway forward for the continued implementation of PBN in the NAS and encourages further collaboration to support acceleration of the benefits of PBN to the NAS and its users.

Background

In 2016, the Federal Aviation Administration (FAA) released the Performance Based Navigation (PBN) National Aviation System (NAS) Navigation (NAV) Strategy. Developed with wide collaboration across the aviation community, the strategy document was well received, endorsed by the NextGen Advisory Committee (NAC) and Performance Based Operations Aviation Rulemaking Committee (PARC). This strategy has served as a guide for both the private and public sector to chart a collaborative course that will successfully and continually transition to a PBN-centric NAS.

Through the deliberations of the PBN NextGen Integration Work Group (NIWG) and subsequent conversations in 2019, it became clear to both industry and the Federal Aviation Administration (FAA) that the initial unanimity with the strategy that existed in 2016 has begun to diverge into new interpretations and new aviation business requirements. In discussing these emerging differences within a small workgroup of personnel from FAA and Industry, the team recognized the need to reset expectations, and refocus collective efforts, commitments, and priorities. In December 2019, FAA Administrator Daniel K. Elwell tasked the NextGen Advisory Committee (NAC) with providing advice to the FAA to ensure the aviation community and the FAA remain synchronized in the delivery and use of PBN capabilities and in achieving operational benefits (NAC Task 19-4: Performance Based Navigation (PBN) Clarification included in Appendix A). This tasking included the three components described below:

- Developing consensus agreement on a PBN baseline (FAA-procedures, industry-equipage);
- Developing consensus agreement on a joint definition of a PBN NAS; and
- Developing consensus agreement on a list of specific desired outcomes, based on gaps in a baseline analysis, for the core 30 airports (minus HNL, plus TEB)[1]

In response, the NAC directed the NAC Subcommittee (NAC SC) Chairman to provide a product that addressed the three elements of the tasking letter. Per the tasking letter scope[2], the NAC SC Chairman formed an ad hoc team that contained three Industry members: the two co-chairs of the PBN NIWG representing major and regional air carriers; and a representative from NBAA for business/general aviation.

The FAA provided three subject matter experts (SMEs) from the Air Traffic Organization (ATO) to ensure recommendations to the NAC are executable from an FAA perspective. These SMEs represented the ATO's Mission Support, Project Management Office, and Operations organizations. The FAA also provided an operational SME from the National Air Traffic Controllers Association (NATCA), documentation support from the NAC facilitation team, and analysis support from the MITRE Corporation.

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[1] For simplicity, this subset of airports is referred to as the Modified Core 30 throughout the rest of the report.

[2] Per the FAA tasking letter, the Ad Hoc Team Industry membership was limited to three representatives, and therefore did not include individual aircraft operators, airport operators, or all of the organizations that represent them on the NAC or NAC SC.

This report documents the response of the Ad Hoc Team to the three elements of the FAA's December 10, 2019 tasking letter (see Appendix A).

Methodology Overview

To address the tasking elements, the Ad Hoc Team conducted a series of meetings between February and July 2020. These meetings are summarized below:

- February 2020: Background briefings and further discussion of tasking scope was provided by the FAA SMEs and MITRE.
- March 2020: In early March, the team discussed procedure types to include in PBN Baseline. Airports of interest to the Industry were also discussed. Later in March, PBN Baseline Industry Equipage (data gathered to date) and PBN Baseline FAA Procedures data were presented and discussed. Ad Hoc Team consensus on task elements 1 and 2 was completed.
- April 2020: FAA provided a list of instrument approaches, SIDs and STARs in development or production (Instrument Flight Procedures (IFP) Gateway) for the Modified Core 30 Airports.
- May 2020: Ad Hoc Team Industry members provided an update on efforts to develop their priority list of desired PBN outcomes.
- June 2020: Ad Hoc Team Industry members presented the findings of their gap analysis and the resulting prioritization of the desired PBN outcomes. FAA SME input was requested to ensure the final recommendations are executable from an FAA perspective.
- July 2020: The FAA SMEs provided feedback on scope, risk and planning implications of the Industry proposals. Ad Hoc Team consensus on task element 3 was completed.

Underlying each of these meetings was the necessity for each Industry Ad Hoc Team member to collect and coalesce inputs from their respective constituencies. The three Industry members used the following methods to obtain input:

- For the major air carriers, A4A (Airlines For America) convened a separate but supporting workgroup made up of representatives from the ten A4A member airlines, along with Frontier Airlines and Spirit Airlines. Each air carrier provided Air Traffic Management and Technical Pilot expertise. This group is referred to as the "PBN Way Forward Group" in this report.
- For regional air carriers, through the Regional Operations Council, RAA formed a team of SMEs from each of the participating airlines. This team served as the source for technical and operational input for RAA.
- For business/general aviation, NBAA consulted its staff and key local members on equipage and operating goals.

The Industry members of the Ad Hoc Team unanimously agreed to use the resources of the PBN Way Forward Group to collate material and contribute airline and business aviation perspectives to this final report. The findings and recommendations for all three tasking elements utilized that

resource, and the breadth of the activity is documented in the final report of the PBN Way Forward Group.[3]

It is important to note that the high-intensity months of COVID-19 pandemic in the United States coincided with the execution of this tasking. Despite operational challenges and other response efforts, the Ad Hoc Team and supporting entities were able to keep focus on the required efforts and deliver a timely response.

Element 1: Developing Consensus Agreement on Definition of a PBN NAS

The Ad Hoc Team endorses the NAS NAV Strategy as the definition of a PBN NAS. The introductory remarks of then-FAA Administrator Michael P. Huerta are still relevant and are an accurate reflection of the definition of a PBN NAS:

> "[The PBN NAS Navigation Strategy] builds on the progress of the past decade and refocuses our priorities and milestones to transition to **a truly PBN-centric NAS, that is, a NAS where PBN is used as the basis for daily operations**. It charts a course that will allow the public and private sectors to advance the NAS collaboratively and constructively for the benefit of all aviation stakeholders, including aircraft operators, the traveling public, as well as new entrants such as unmanned aircraft systems and commercial space vehicles."

The Ad Hoc Team recognizes that the delivery of the full suite of benefits from a PBN NAS may be dependent on the implementation of other NAS capabilities as well as successful operational change management. As noted in the NAS NAV Strategy, shifting to time- and speed-based air traffic management is one of the achievements needed to complete the transition to a PBN NAS[4].

Final Recommendation: Reaffirmation of definition of PBN-centric NAS contained in the NAS NAV Strategy, to include the Focus Areas from page 11 of the strategy document:

- Operating with PBN throughout the NAS, using the right procedure to meet the need;
- Using navigation structure where beneficial and flexibility where possible;
- Shifting to time- and speed-based air traffic management;
- Delivering and using resilient navigation services;
- Modernizing the FAA navigation service delivery to reduce implementation time;
- Enabling lower visibility access; and
- Innovating and continuously improving.

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[3] "Final Report of the Major Air Carrier Performance Based Navigation (PBN) Way Forward Workgroup for the FAA's PBN Clarification Tasking to the NextGen Advisory Committee (NAC)," June 2020.

[4] From "Navigation Strategy Overview," page 11 of FAA's 2016 PBN NAS Navigation Strategy.

Element 2: Developing Consensus Agreement on a PBN Baseline

The FAA Tasking Letter identifies two elements that would make up a PBN baseline: instrument flight procedures, to be assessed by the FAA; and aircraft equipage, to be assessed by the aviation community.

PBN Baseline Procedures

In early March, the FAA SMEs presented a list of procedure types that the FAA intended to include in their baseline calculations:

- Area Navigation (RNAV) Standard Instrument Departures (SIDs) and Standard Terminal Arrivals (STARs)
- RNAV Global Positioning System (GPS) approaches
- Required Navigation Performance Authorization Required (RNP (AR)) approaches

The Ad Hoc Team accepted the FAA's list but requested additions to reflect other PBN procedures that currently exist in the NAS, including:

- RNP to xLS (ILS/GLS)
- Advanced RNP (A-RNP) (SIDs, STARs, Approaches)
- Ground Based Augmentation System Landing System (GLS) Approaches
- RNAV Visual Flight Procedures (RVFP)

The last four procedure types listed (RNP to xLS, A-RNP, GLS, and RNAV Visual) are not new concepts developed by the Ad Hoc Team. All but RNAV Visuals are part of the NAS NAV Strategy but it should be noted that while A-RNP procedures exist at some locations in the NAS, they are in various stages of development and maturity.

Final Recommendation: The PBN baseline for procedures should reflect the PBN procedures that currently exist in the NAS.

PBN Baseline Equipage

The NAC Minimum Capabilities List (MCL) was used to identify the PBN capabilities for Approach and Terminal phases. For the major air carriers and regional air carriers a review of the relevant Operations Specifications (Ops Specs) was considered to be the best way to report the current equipage capability of the respective fleets and pilots. Ops Specs are a real-time representation of an air carrier's capability, to include what is equipped, trained and FAA-approved. Table 1 used the information from Ops Specs C052, C063 and C384 (where applicable) along with the total fleet size to calculate equipage percentages. The equipage baseline did not include the basic RNAV terminal capabilities that are nearly 100% for the major air carriers and have been reported by the FAA and MITRE for several years. The data collection focused on MCL approach capabilities, including RNP AR, A-RNP, and coupled VNAV. Advisory VNAV is included in Table 1 to account for aircraft lacking approved vertical guidance for RNAV (GPS) approaches. Additional information on two supplemental items is also included: GLS and LPV (Localizer Performance with Vertical Guidance) capabilities.

Table 1 contains the summary of baseline equipage and capability for the PBN elements of the terminal and approach components of the MCL for the major air carriers and for most of regional

airlines. An additional breakdown by air carrier is provided in Appendix B. The fleet information was updated at the beginning of June 2020. However, it is important to note that the fleet complement decisions are ongoing and may change as the COVID-19 recovery occurs.

Table 1 – Combined Air Carrier Baseline PBN Equipage

		Baseline MCL						Supplemental MCL	
		Approach					Terminal	Approach	
			A-RNP		RNAV (GPS)				
Air Carrier	Counts	RNP AR	Capable	Ops Spec	Coupled VNAV	Advisory VNAV only	RNP-1 w RF	GLS	LPV
Majors	4,644	76%	89%	65%	98%	2%	90%	14%	1%
Regionals	1,881	23%	23%	0%	43%	57%	23%	0%	0%

The approach using Ops Specs to determine a current baseline equipage is not as applicable to general or business aviation, however, there have been cooperative studies between AOPA and MITRE[5]. The analysis shows RNAV and RNP equipage to be relatively high for IFR aircraft (83%-87%, depending on type of aircraft, and over 90% for business aviation jet fleet).

NBAA completed an analysis of a typical day of operations (pre-COVID-19 traffic reduction) at Teterboro Airport. This traffic is representative of business aviation operations into a dense air traffic, Core 30 environment. From that analysis, RNAV and RNP equipage was well over 98%. This is indicative of typical equipage for business aviation operators utilizing Core 30 or NSG1 airports. A-RNP and RNP AR percentages tend to be lower - on the specific day sampled, ~26% of daily TEB operations were A-RNP equipped and ~30% have a retrofit option.

Due to the resiliency requirement for Inertial Reference Unit (IRU) equipment that is used in the case of a GPS system outage, much of the business/general aviation fleet will not be fully equipped for RNP AR approaches. Even for some of the fleet that are RNP AR capable and equipped with an IRU, they cannot fly radius-to-fix (RF) legs due to map display limitations and ultimately would not qualify as equipped. For example, the Bombardier Challenger CL300 with the Proline 21 enhanced flight deck has many similar capabilities to the CL350 variant, except it does not have an IRU, which makes it eligible for A-RNP, but not RNP AR.

Final Recommendation: The PBN baseline for equipage for major and regional air carriers should be collected based on information in the existing Ops Specs.

Element 3: Developing Consensus Agreement on a List of Specific Desired PBN Outcomes

The third tasking element requests a consensus aviation community agreement on a list of specific desired outcomes, based on gaps in a baseline analysis, for the Modified Core 30

[5] From February 13, 2020 MCL meeting presentation by Rune Duke, "AOPA MCL Presentation v2" pages 4-6.

airports. The intent of this element was to identify a set of site-specific recommendations providing a clear portrayal of airline and business aviation PBN priorities with understanding of what is executable from the FAA's perspective. The timeframe for these desired PBN outcomes is 2021 to 2025, described as the "mid-term" in the NAS NAV Strategy.

The Industry Ad Hoc Team members unanimously agreed to use A4A's PBN Way Forward Group augmented with representatives from RAA and NBAA to develop the list of desired PBN outcomes. A set of priority airports (see Appendix C) and specific PBN proposals associated with each airport were identified. These proposals were compared with the list of PBN procedures in development/production supplied by the FAA SMEs. Finally the proposals were assessed for readiness and return, using airline, A4A, RAA and NBAA expertise and experience. The process used is summarized in Appendix D and is documented in full detail in the final report of the PBN Way Forward Group. The resulting 48 PBN proposals, in order of readiness and return scoring, are shown in Table 2.

Table 2 – Desired PBN Outcomes

01 SFO: Amend SSTIK to replace OFFSHORE	25 ORD: Optimized SIDs/STARs
02 DCA: RNAV (GPS) for Rwy 19	26 PHX: Offload RNAV STAR for NE corner
03 CVG: OPDs, CCOs, RNP w RF	27 EWR/TEB: MARS application
04 JFK/LGA: SKORR/GLDMN departures	28 DCA: RNAV (RNP) for Rwy 01
05 ATL: LNAV for parallel ops	29 MEM: xLS transitions and A-RNP to all runways
06 EWR: Align RNAV with ILS; revise RNP Rwy 29	30 DAL/DFW: MARS application
07 LGA: RNAV (GPS) for Rwy 31	31 PHL: RNAV (GPS) for Rwys 09L/R
08 TEB: Rwy 19 offset and RUUDY departure	32 DCA: CLIPR/DEALE optimization
09 SLC: STARs/SIDs in Gateway	33 SEA: RNAV STARs and RNPs from east
10 LAX: A-RNP approaches (enables EoR)	34 HOU: RNAV (RNP) to Rwys 13R, 31L, 22, 04
11 IAH: RNP AR for Rwys 27 & 08L (enables EoR)	35 SLC: Curved approach for Rwy 35
12 TEB: RNAV SID for Rwy 19	36 SLC: RF/TF overlay with xLS (enables EoR)
13 BOS: Rwy 04L GPS offset with VNAV	37 SFO: GLS applications/procedures
14 SEA: ELSO departures	38 SFO/OAK: MARS application
15 SDF: Redesigned SIDs/STARs (enables EoR)	39 FLL: RNP approaches (enables EoR)
16 IAD: Procedures amendments (enables EoR)	40 BOS: RNP(AR) for Rwy 22L with GPS overlay
17 EWR: Replace vectors SIDs	41 MCO: RNP approaches (enables EoR)
18 DAL: Approaches for Rwy 13L/R and 31L/R	42 EWR: .308 procedures for parallel operations
19 TEB: RNAV to replace conventional procedures	43 SFO: .308 procedures for Rwys 19L/R operations
20 PDX: EoR with waiver	44 EWR: GLS applications/procedures
21 BNA: A-RNP approaches (enables EoR)	45 LGA: GLS applications/procedures
22 JFK: Approaches for Rwys 13L/R (enables EoR)	46 JFK: GLS applications/procedures
23 ATL: RF/TF overlay with xLS (enables EoR)	47 IAH: GLS applications/procedures
24 DFW: Offload RNAV STAR for NE corner	48 ATL: GLS applications/procedures

The proposals in Table 2 are based on the input and consensus of the major air carriers (reflected by the inputs of A4A's PBN Way Forward Group), regional airlines (reflected by the inputs of RAA's Regional Operations Council), and business/general aviation (reflected by the inputs of NBAA). The Industry Ad Hoc Team members have identified these 48 proposals as the desired PBN outcomes, serving as the fundamentals needed to achieve the objectives, address requirements, and meet expectations of the NAS NAV Strategy. More immediately, these

priorities can be used to refresh the PBN production process and help the FAA move forward on the backlog of procedure requests[6] in the IFP Gateway.

The Industry Ad Hoc Team members requested input from the FAA SMEs as to which of the proposals were most consistent with current FAA planning. This discussion started in June and clarifications to the FAA's questions have been included in the procedure detail tables in Appendix D. The FAA SMEs indicated their assessment will proceed after delivery of this report, and will ascertain which proposals are beyond the scope of the current tasking (for example if they require additional airspace or infrastructure investments outside the bounds of the FAA's single-site PBN development efforts), or have other operational risk elements that the FAA does not have plans to address. Some of the proposals in Table 2 target airports that were not included in the FAA's tasking letter, specifically cargo hubs. The FAA indicated that these additional airports could be considered on a case-by-case basis and if resources are available.

Final Recommendation: The desired PBN outcomes are represented in these 48 proposals. Request that the FAA complete its assessment of the desired PBN outcomes as soon as practical. Collaborative discussions concerning all 48 PBN proposals will continue, to support additional action in transitioning to a PBN NAS. Subsequent development and/or implementation efforts should start as soon as practical, including competing feasibility studies if needed.

Ancillary Findings for FAA Consideration

As stated previously, the deliberative process was comprehensive and due to the thorough nature of the discussions, there were a number of observations beyond the three elements of the tasking that were uncovered. These topics included an array of items including process improvement, operational scope, future goals, and enabling capabilities. The team acknowledges that these topics are not part of the scope of the tasking; however we believe that they should be noted for action in the future.

Capacity of FAA's Current PBN Implementation Process: The NAS NAV Strategy calls for a level of PBN development that FAA processes and resources may not be able to meet. The prioritized procedures in this document only serve as a starting point, and demand for PBN to support further proliferation will only increase. Constraints must be addressed and other forms of production (e.g. third-party development support) may be needed to augment FAA resource limitations.

Transparency into the PBN Prioritization and IFP Gateway: FAA transparency and accountability for PBN development and implementation is essential. This transparency, at a minimum, should include tracking the status of each proposal after it is logged into the IFP Gateway, communicating an accurate schedule, and coordinating necessary Industry input.

Widespread Deployment of Established on RNP (EoR): EoR is featured prominently in the PBN NAS NAV Strategy and in the results of this effort as well. The Desired PBN Outcomes

[6] Procedure requests must undergo the normal IFP development process under Order 8260.43, including validation, airport coordination, and scheduling as well as environmental review.

documented in this report include new procedures and adjustments to approaches to enable EoR for over a third of the priority airports. Further criteria work is needed to more fully leverage these capabilities where they can provide benefits and enhance safety at more locations in the NAS.

Expediting MARS (Multiple Airport Route Separation) Standards and Implementation: Along with EoR, MARS has been identified as a priority concept that leverages PBN capabilities. Expediting MARS studies and other research efforts is needed to generate positive outcomes that are expected to increase the utilization of PBN operations across the NAS and enable time-based sequencing and spacing of air traffic.

Broader Airport Consideration: A PBN NAS includes the whole NAS, and prioritization should include all NSG1 and NSG2 airports. The use of the Modified Core 30 list does not fit easily within the NSG structure and should be reconsidered for future PBN prioritization.

NAS-wide Proliferation of PBN: Since the NAS NAV Strategy was published, the FAA and Industry have grappled with challenges to large-scale proliferation of PBN. Concerns associated with mitigation actions have been continually raised, including issues surrounding vertical navigation capabilities. Additional collaborative efforts, specifically addressing these concerns, are underway as part of separate NAC tasking[7].

Closing and Recommendations

The material documented in this report clearly reflects the continued dedication of the aviation community in the support of the NAS NAV Strategy in developing PBN. The consensus recommendations of the Ad Hoc Team associated with the three elements of the tasking include:

- Element 1: Reaffirmation of definition of PBN-centric NAS contained in the NAS NAV Strategy, to include the Focus Areas from page 11 of the strategy document.
- Element 2: The PBN baseline for procedures should reflect the PBN procedures that currently exist in the NAS. The PBN baseline for equipage for major and regional air carriers should be collected based on information in the existing Ops Specs.
- Element 3: The desired PBN outcomes are represented by the 48 proposals in Table 2. Request that the FAA complete its assessment of the desired PBN outcomes as soon as practical. Collaborative discussions concerning all 48 PBN proposals will continue, to support additional action in transitioning to a PBN NAS. Subsequent development and/or implementation efforts should start as soon as practical, including competing feasibility studies if needed.

The Ad Hoc Team also identified the need to continued standards efforts and safety studies to expedite implementation of key concepts (e.g. EoR, MARS) and continued of transparency into the FAA's PBN prioritization efforts. Future prioritization could benefit from consideration of a broader set of airports (NSG1 and NSG2), utilization of the aviation community as an important resource in continued advancement of PBN, and proactive inclusion of all appropriate operator

[7] NAC Task 20-2: Vertical Navigation (VNAV) is included in the August 10, 2020 tasking letter from Dan Elwell.

perspectives in the FAA's efforts to address the broad array of PBN development efforts (e.g. new orders, planning, etc.).

The Ad Hoc Team is confident that the FAA will see the value of these efforts and the positive dialog that this work has started. The information included in this report should provide a path for moving forward and intensify PBN implementation efforts.

Appendix A: FAA Tasking Letter

U.S. Department of Transportation
Federal Aviation Administration

Office of the Deputy Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

December 10, 2019

Mr. Russell "Chip" Childs
President and Chief Executive Officer
SkyWest, Inc.
444 South River Road
St. George, UT 84790

Dear Mr. Childs:

It has been several years since the publication of the 2016 Performance Based Navigation (PBN) National Airspace System (NAS) Navigation Strategy. Now is an appropriate time to gain further advice from the NextGen Advisory Committee (NAC) to ensure the aviation community and Federal Aviation Administration (FAA) remain synchronized in the delivery and use of PBN capabilities and in achieving operational benefits. The FAA requests further definition and advice from the NAC, in the form of the following task:

Task 19-4: Performance Based Navigation (PBN) Clarification

The NAC is asked to provide aviation community consensus advice by:

- Developing consensus agreement on a PBN baseline (FAA-procedures, industry-equipage);
- Developing consensus agreement on a joint definition of a PBN NAS; and
- Developing consensus agreement, based on gaps in baseline analysis at Core 30 airports (minus HNL, plus TEB), on a list of specific desired outcomes.

Scope:

- FAA will provide MITRE data;
- Limited to three NAC and three FAA participants; and
- Complete work within three months of start.

This advice should be provided to the FAA no later than the summer 2020 NAC meeting in the form of a report. If you have questions, please contact Pamela Whitley, Acting Assistant Administrator for NextGen, at Pamela.Whitley@faa.gov.

Sincerely,

DKElwell

Daniel K. Elwell
Deputy Administrator

Appendix B: Detailed Equipage Information

Major Air Carrier Baseline PBN Equipage

	Baseline MCL						Supplemental MCL	
	Approach					Terminal	Approach	
		A-RNP		RNAV (GPS)				
Air Carrier	RNP AR	Capable	Ops Spec	Coupled VNAV	Advisory VNAV only	RNP-1 w RF	GLS	LPV
Alaska	84%	100%	100%	100%	0%	100%	0%	0%
American	73%	100%	100%	100%	0%	100%	0%	0%
Atlas	0%	44%	0%	82%	18%	44%	0%	0%
Delta	84%	89%	14%	89%	11%	89%	47%	5%
FedEx	63%	100%	63%	100%	0%	83%	0%	0%
Frontier	100%	100%	0%	100%	0%	100%	0%	0%
Hawaiian	0%	0%	0%	100%	0%	0%	0%	0%
JetBlue	100%	100%	100%	100%	0%	100%	3%	0%
Southwest	100%	100%	100%	100%	0%	100%	7%	0%
Spirit	0%	100%	100%	100%	0%	100%	0%	0%
United	77%	77%	59%	100%	0%	87%	28%	0%
UPS	56%	66%	0%	100%	0%	66%	0%	0%

Regional Air Carrier Baseline PBN Equipage

	Baseline MCL						Supplemental MCL	
	Approach					Terminal	Approach	
		A-RNP		RNAV (GPS)				
Air Carrier	RNP AR	Capable	Ops Spec	Coupled VNAV	Advisory VNAV only	RNP-1 w RF	GLS	LPV
Air Wisconsin	0%	0%	0%	0%	100%	0%	0%	0%
Cape Air	0%	0%	0%	100%	0%	0%	0%	0%
CommutAir	0%	0%	0%	0%	100%	0%	0%	0%
Empire	0%	0%	0%	0%	100%	0%	0%	0%
Endeavor	0%	0%	0%	0%	100%	0%	0%	0%
Envoy	0%	0%	0%	54%	46%	0%	0%	0%
ExpressJet	0%	0%	0%	21%	79%	0%	0%	0%
GoJet	0%	0%	0%	0%	100%	0%	0%	0%
Horizon	100%	100%	0%	100%	0%	100%	0%	0%
Mesa	0%	0%	0%	41%	59%	0%	0%	0%
Piedmont	0%	0%	0%	0%	100%	0%	0%	0%
PSA	0%	0%	0%	70%	30%	0%	0%	0%
Republic	100%	100%	0%	100%	0%	100%	0%	0%
SkyWest	31%	31%	0%	31%	69%	31%	0%	0%

The fleet equipage information was originally collected in early 2020 and last updated at the beginning of June 2020. However, it is important to note that the fleet complement decisions are ongoing and may change as the COVID-19 recovery occurs.

Along with the current Ops Specs information, there are some expected future capabilities that should also be noted:

- Through aircraft acquisition, Ops Specs augmentation, and equipment upgrades, UPS expects to increase its approach capabilities to 86% RNP AR and A-RNP capable, 19% LPV capable, and increase the en route RNP 2 capability to 100%.
- With respect to GLS capabilities, Southwest Airlines future Boeing 737 MAX aircraft will all be GLS capable and the airline has started to retrofit its fleet to be equipped to meet requirements for GLS before the end of the mid-term. JetBlue's current and future Airbus NEO aircraft will also be equipped with GLS capabilities. GLS capability is expected to increase as equipped Boeing 737 MAX aircraft are added back into the operation.

Appendix C: Airports

AIRPORT		NSG	Core 30	Modified Core 30	Aircraft Operator Priority
IAD	Washington Dulles International	1	✓	✓	✓
SFO	San Francisco International	1	✓	✓	✓
DCA	Ronald Reagan Washington National	1	✓	✓	✓
PHL	Philadelphia International	1	✓	✓	✓
EWR	Newark Liberty International	1	✓	✓	✓
LAX	Los Angeles International	1	✓	✓	✓
LGA	La Guardia	1	✓	✓	✓
JFK	John F Kennedy International	1	✓	✓	✓
ATL	Hartsfield - Jackson Atlanta International	1	✓	✓	✓
IAH	George Bush Intercontinental/Houston	1	✓	✓	✓
DEN	Denver International	1	✓	✓	✓
DFW	Dallas/Fort Worth International	1	✓	✓	✓
ORD	Chicago O'Hare International	1	✓	✓	✓
CLT	Charlotte/Douglas International	1	✓	✓	✓
BWI	Baltimore/Washington Intl Thurgood Marshall	1	✓	✓	✓
SEA	Seattle-Tacoma International	2	✓	✓	✓
SLC	Salt Lake City International	2	✓	✓	✓
PHX	Phoenix Sky Harbor International	2	✓	✓	✓
MCO	Orlando International	2	✓	✓	✓
MEM	Memphis International	2	✓	✓	✓
BOS	General Edward Lawrence Logan International	2	✓	✓	✓
FLL	Fort Lauderdale/Hollywood International	2	✓	✓	✓
TPA	Tampa International	2	✓	✓	
SAN	San Diego International	2	✓	✓	
MSP	Minneapolis-St Paul Intl/Wold-Chamberlain	2	✓	✓	
MIA	Miami International	2	✓	✓	
LAS	McCarran International	2	✓	✓	
HNL	Honolulu International	2	✓		
DTW	Detroit Metropolitan Wayne County	2	✓	✓	
MDW	Chicago Midway International	2	✓	✓	
HOU	William P Hobby	2			✓
TEB	Teterboro	2		✓	✓
PDX	Portland International	2			✓
BNA	Nashville International	2			✓
SDF	Louisville International-Standiford Field	2			✓
DAL	Dallas Love Field	2			✓
CVG	Cincinnati/Northern Kentucky International	2			✓

Appendix D: Defining Desired PBN Outcomes and Procedure Details

The Industry members for the Ad Hoc Team relied on the thorough and methodical process[8] used by the PBN Way Forward Group to develop a set of desired PBN outcomes for 2021-2025. The process started with each participant (air carrier or organization) identifying their top priority airports. For each priority airport, detailed information on the desired PBN outcomes and procedures was gathered. The aircraft operator consensus identified 48 PBN proposals across 26 airports. Each proposal was evaluated for its potential readiness and expected return. Subjective scoring (high, medium, low) based on a set of specific guidelines was used for this evaluation. From the individual scoring inputs, an average Readiness score and Return score was calculated:

- "Readiness" is meant to reflect the overall ability of the system to use the proposed change. It includes more than just an assessment of risk, by looking at the potential mitigation of risks. For PBN, addressing the operational and technical readiness is crucial. Example readiness considerations include whether the procedure(s) in development, level of equipage, assumed system acceptance, availability of decision support tools (if required), whether policy or criteria changes are required, and if there are community/environmental concerns.
- "Return" is meant to reflect the expected realizable benefit, in particular whether the procedure(s) address both safety and efficiency benefits. It includes an assessment of whether the proposal provides benefit to the majority of operations, and promotes operational goals at local and national levels. It should also include the extent that the proposal supports looking forward to the mid-term and long-term goals of the NAS NAV Strategy.

Figure 1 contains the results of the Readiness and Return scoring efforts. Each point in the plot represents one PBN proposal, with the Readiness scores plotted along the x-axis and the Return scores plotted along the y-axis.

Along with the procedures, there are several operational themes or concepts referenced in the proposals. In many cases, the procedures are priorities because they will enable emerging concepts included in the goals and commitments in NAS NAV Strategy and other NAS planning documents, such as RNP to xLS, A-RNP, EoR, Equivalent Lateral Spacing Operations (ELSO) and MARS.

When reviewing and interpreting the scoring and prioritization results presented in Figure 1, the following points should be considered. The 48 proposals and associated procedures all have a degree of positive return and constructive readiness. The proposals in the upper right portion of Figure 1 have the highest Readiness and Return scores, and could be viewed as a necessary foundation, but limiting focus to those higher scoring proposals is not sufficient to address the mid-term priorities defined by this consensus effort.

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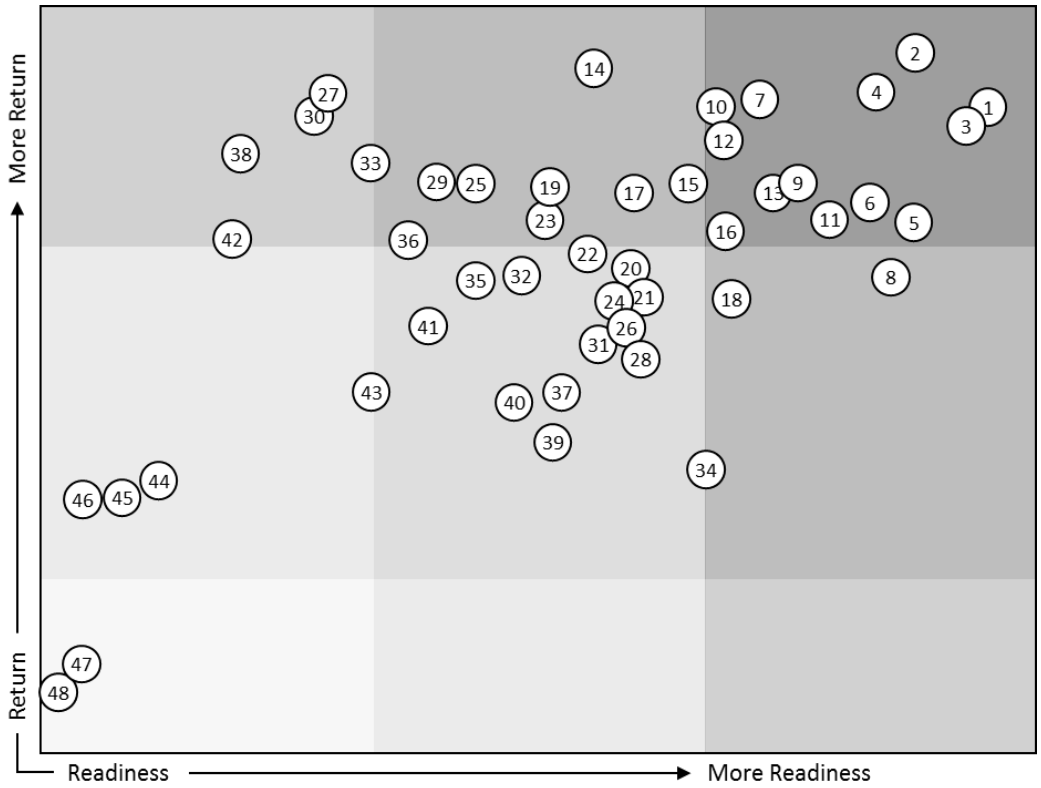
[8] This methodology was developed by the PBN Way Forward effort and was wholeheartedly adopted by the PBN Ad Hoc Team Industry members.

Figure 1: Summary of Readiness and Return Scores



1 SFO: Amend SSTIK and retire OFFSHORE
2 DCA: RNAV (GPS) for Rwy 19
3 CVG: OPDs, CCOs, RNP w RF
4 JFK/LGA: SKORR/GLDMN departures
5 ATL: LNAV for parallel ops
6 EWR: Align RNAV with ILS, revise RNP Rwy 29
7 LGA: RNAV (GPS) for Rwy 31
8 TEB: Rwy 19 offset and RUUDY departure
9 SLC: STARs/SIDs in IFP gateway
10 LAX: A-RNP approaches (enables EoR)
11 IAH: RNP(AR) for Rwys 27 & 08L (enables EoR)
12 TEB: RNAV SID for Rwy 19
13 BOS: 4L GPS offset with VNAV
14 SEA: ELSO in existing departure corridor
15 SDF: Redesigned SIDs/STARs (enables EoR)
16 IAD: Capital Redesign (enables EoR)
17 EWR: Replace vectors SIDs
18 DAL: Approaches for Rwy 13L/R and 31L/R
19 TEB: RNAV to replace conventional procedures
20 PDX: EoR with waiver
21 BNA: A-RNP approaches (enables EoR)
22 JFK: Approaches for Rwys 13L/R (enables EoR)
23 ATL: RF/TF overlay with xLS (enables EoR)
24 DFW: Offload RNAV STAR for NE corner
25 ORD: Optimized SIDs/STARs
26 PHX: Offload RNAV STAR for NE Corner
27 EWR/TEB: MARS application
28 DCA: RNAV (RNP) for Rwy 01
29 MEM: xLS transitions and A-RNP to all runways
30 DAL/DFW: MARS application
31 PHL: RNAV (GPS) for Rwys 09L/R
32 DCA: CLIPR/DEALE optimization
33 SEA: RNAV STARs and RNPs from east
34 HOU: RNAV (RNP) to Rwys 13R, 31L, 22, 04
35 SLC: Curved approach for Rwy 35
36 SLC: RF/TF overlay with xLS (enables EoR)
37 SFO: GLS applications/procedures
38 SFO/OAK: MARS application
39 FLL: RNP approaches
40 BOS: RNP(AR) for Rwy 22L with GPS overlay
41 MCO: RNP approaches
42 EWR: .308 procedures for parallel operations
43 SFO: .308 procedures for Rwys 19L/R operations
44 EWR: GLS applications/procedures
45 LGA: GLS applications/procedures
46 JFK: GLS applications/procedures
47 IAH: GLS applications/procedures
48 ATL: GLS applications/procedures

This section of the appendix includes additional detail and descriptions concerning the PBN proposals presented in Table 2 of the report and in Figure 1 above. The format is as follows:

[#] Airport – Short Proposal Title Proponent: *Airline or Aircraft Operator*	*Summary of the proposal including brief description of desired outcomes/benefits.*	
SIDs: *list SIDs to modify or new SIDs needing development*	STARs: *list STARs to modify or new STARs needing development*	APCHs: *list approaches to modify or new approaches needing development*
Additional Comments: *Further explanation of the proposal and/or cross reference to other workgroups where the proposal has been discussed.*		

The number in brackets (e.g. [1]) preceding the airport identifier and proposal title corresponds to the proposal number in Figure 1.

The information in this section of the appendix is intended to aid the reader in understanding the specifics of the proposals, it is expected that additional questions may arise. The "proponent" is identified in case the FAA or other report readers have questions or require additional explanation.

PBN Proposal Descriptions

[1] SFO – Amend SSTIK to replace OFFSHORE Proponent: United, Alaska	Modify the YYUNG transition on the Metroplex RNAV SID to make it useable for ATC and eliminate FSAP/ATSAP safety concerns	
SIDs: SSTIK	STARs:	APCHs:
Additional Comments: YYUNG transition was intended to replace the conventional OFFSHORE SID. Amending the OFFSHORE so it can be coded for FMS is alternate method to address safety concerns.		
[2] DCA – RNAV (GPS) for Rwy 19 Proponent: American	Complete RNAV (GPS) approach for Runway 19 for access and noise benefit	
SIDs:	STARs:	APCHs: RNAV (GPS) Rwy 19
Additional Comments: Procedures found in IFP Gateway production plan.		
[3] CVG – OPDs, CCOs, RNP w RF Proponent: Atlas	Modified and new STARs (OPDs), SIDs (CCOs), and GPS overlays of RNPs	
SIDs: Modify existing SIDs – BNGLE KENLN CHCLL LOVEY GIPLE ROCKT HAGOL SILKS JBNCH	STARs: Modify existing STARs – CEGRM GAVNN JAKIE SARGO TIGRR	APCHs: new RNP approaches for each runway end (8 total) – RNAV (RNP) Rwy 18L/C/R RNAV (RNP) Rwy 36L/C/ RNAV (RNP) Rwy 27 RNAV (RNP) Rwy 09
Additional Comments: Designs started in 2017 and found in IFP production plan. RNAV (GPS) approaches were modified with TF legs to mimic the RF leg in the RNP approach; ILS procedures would have been updated with the new course fixes.		

PBN Proposal Descriptions (continued)

[4] JFK/LGA – SKORR/GLDMN departures Proponent: JetBlue, Delta	Enable simultaneous use of RNAV SID departures using altitude separation, JFK SKORR and LGA GLDMN departures to increase throughout and reduce noise impacts	
SIDs: enabled by existing procedures; modifications may be needed	STARs:	APCHs:
Additional Comments: This proposal has also been identified as an Industry priority by the NEC NIWG and NAC SC Opportunities discussion group.		
[5] ATL – LNAV for parallel ops Proponent: Delta	Enable LNAV for parallel ops (remove note and authorize minima) to increase efficiency with independent simultaneous operations, and to not cause confusion about the use of LNAV minima during ILS outages; for current straight-in procedures	
SIDs:	STARs:	APCHs: all applicable approaches
Additional Comments: ALPA recommends removal of this item in line with its consistently stated opposition to closely spaced parallel runway operations using LNAV (only) minima. However, ALPA also understands the Ad Hoc Team's intent to preserve the findings that informed this report. ALPA requests that the findings and outcomes from NAC Tasking 20-2 Vertical Navigation inform further action on operations using LNAV (only) minima on closely spaced parallel runways.		
[6] EWR – Align RNAV with ILS; RNP Runway 29 Proponent: United	Align RNAV fix names with ILS/GPS for approaches; and stabilize approach by revising RNP Rwy 29 with updated criteria	
SIDs:	STARs:	APCHs: RNAV (RNP) Rwy 29 RNAV (GPS) Rwy 04L/R RNAV (RNP) Rwy 11 RNAV (RNP) Rwy 22L RNAV (GPS) Rwy 22R
Additional Comments: The RNAV (RNP) Rwy 29 proposal is related to priorities identified in the NEC NIWG and NAC SC Opportunities discussion group. The existing RNP was developed back in 2008; does not have CAT D minima and has wide RF turns due to the older criteria (creates proximity issues with LGA). New bank angle criteria (from PARC NAV WG) and other changes in criteria could produce more acceptable approach.		
[7] LGA – RNAV (GPS) for Rwy 31 Proponent: Delta	Develop public RNAV (GPS) to mimic the Expressway Visual to LGA Rwy 31 to provide stable, repeatable approach	
SIDs:	STARs:	APCHs: RNAV (GPS) Rwy 31 to emulate Expressway Visual
Additional Comments: This proposal has also been identified as an Industry priority by the NEC NIWG and NAC SC Opportunities discussion group.		
[8]TEB – Rwy 19 offset & RUUDY dep Proponent: NBAA	Complete RNAV offset (X) Rwy 19 and update to RUUDY departure providing access and predictability	
SIDs: RUUDY	STARs:	APCHs: RNAV (GPS) Rwy 19 offset
Additional Comments: RUUDY update and Rwy 19 offset approach are both included in IFP Gateway production plan.		

PBN Proposal Descriptions (continued)

[9] SLC – STARs/SIDs in Gateway Proponent: Delta	Complete work on SIDs/STARs in IFP Gateway to address safety concerns with existing procedures	
SIDs: RUGGD TWO	STARs: LEEHY SPAVE	APCHs: RNAV (GPS) Rwy 34L RNAV (GPS) Rwy 35
Additional Comments: Ongoing work with Western Service Area. Procedures found in IFP Gateway production plan.		
[10] LAX – A-RNP approaches Proponent: Southwest	Add A-RNP approach minimums to existing RNAV (RNP) approaches to enable EoR, increase efficiency, and help address community concerns	
SIDs:	STARs:	APCHs: A-RNP for Rwy 06L/R A-RNP for Rwy 07L/R A-RNP for Rwy 24L/R A-RNP for Rwy 25L/R
[11] IAH – RNP AR for Rwys 27 & 08L Proponent: United	Complete RNP AR approaches to Runways 27 and 08L to finish EoR project at IAH, providing flight time and distance savings	
SIDs:	STARs:	APCHs: RNP AR Rwy 27 RNP AR Rwy 08L
Additional Comments: This proposal has also been identified as an Industry priority by the PBN NIWG and in the Barriers to EoR Report.		
[12] TEB – RNAV SID Rwy 19 Proponent: NBAA	Improve departure efficiency with TEB 19 Departure Procedure and implementation of NEC Escape Routes	
SIDs: Rwy 19 RNAV	STARs:	APCHs:
Additional Comments: This proposal has also been identified as an Industry priority by the NEC NIWG.		
[13] BOS – Rwy 04L GPS offset with VNAV Proponent: JetBlue	Provides stabilized approaches and prevents misidentification of the landing runway with GPS offset to Rwy 04L with VNAV minima	
SIDs:	STARs:	APCHs: RNAV (GPS) Rwy 04L
Additional Comments: Minimal offset (2 degree) to ensure alignment with proper runway. This request pertains initially to single runway operations; however, Appendix A of JO 7110.308 includes 04L/04R for simultaneous dependent approaches to closely spaced parallel runways. The procedure will be properly annotated with "LNAV not authorized." for closely spaced parallel operations (similar to SFO procedures), and both wake turbulence separation and approved vertical guidance are required when operating under JO 7110.308.		
[14] SEA – ELSO departures Proponent: Alaska	Reduce ground congestion and expedite departures with ELSO, using the existing departure corridor	
SIDs: new RNAV SIDs – Rwy 16L/C/R RNAV Rwy 34L/C/R RNAV	STARs:	APCHs:
Additional Comments: Designs started in workgroup but shelved outside Gateway.		
[15] SDF – Redesigned SIDs/STARs Proponent: UPS	Optimize profiles, add efficiency, mitigate noise through 4 STARs with EoR approach transitions, 8 SIDS incorporating	
SIDs: 8 new departure procedures	STARs: 8 new arrival procedures	APCHs: 4 transitions (for EoR)

PBN Proposal Descriptions (continued)

<table>
<tr><td>[16] IAD – Procedures amendments
Proponent: United</td><td colspan="2">Increase efficiency and enhance safety by completing procedure amendments, modify STARs, enable EoR on widely spaced runways</td></tr>
<tr><td>SIDs:</td><td>STARs: Modify existing STARs –
CAVLR LEGGO
GIBBZ MAPEL
HYPER WIGOL</td><td>APCHs:
RNAV (RNP) Rwy 01L/C/R
RNAV (RNP) Rwy 19L/C/R
RNAV (GPS) Rwy 30
RNP AR for EoR</td></tr>
<tr><td colspan="3">Additional Comments: STARs and approaches are in the IFP Gateway production plan. In order to implement triple simultaneous independent approaches, the ILS approaches will need updated altitudes (ILS Rwy 01L/C/R, ILS Rwy 19L/C/R).</td></tr>
<tr><td>[17] EWR – Replace vector SIDs
Proponent: United</td><td colspan="2">Replace vector SIDs with open SIDs, addressing workload concerns and enhancing safety</td></tr>
<tr><td>SIDs: new open SIDs</td><td>STARs:</td><td>APCHs:</td></tr>
<tr><td colspan="3">Additional Comments: Requesting overlaying existing vector SIDs with an RNAV open SID. Can mirror the existing ground track, while using standard RNAV leg types that would be flyable with the FMC.</td></tr>
<tr><td>[18] DAL – Approaches for Rwy 13L/R and 31L/R
Proponent: Southwest</td><td colspan="2">Enhance safety and access with 12 new approaches (ILS, GPS, RNP for each runway); will enable MARS-like operations</td></tr>
<tr><td>SIDs:</td><td>STARs:</td><td>APCHs:
Rwy 13L/R ILS, GPS, RNP
Rwy 31L/R ILS, GPS, RNP</td></tr>
<tr><td>[19] TEB – RNAV to replace conventional procedures
Proponent: NBAA</td><td colspan="2">Replace conventional procedures with RNAV for enhanced safety and access: Rwy 01/Rwy 06 SIDs and RNAV STAR to replace LVZ4</td></tr>
<tr><td>SIDs: Rwy 01 RNAV
Rwy 19 RNAV</td><td>STARs: RNAV to replace LVZ4</td><td>APCHs:</td></tr>
<tr><td colspan="3">Additional Comments: This Rwy 19 RNAV SID has also been identified as an Industry priority by the NEC NIWG.</td></tr>
<tr><td>[20] PDX – EoR with waiver
Proponent: Alaska, RAA</td><td colspan="2">Enable EoR with waiver to conduct simultaneous dependent approaches, increase use of RNPs and enable efficient operations</td></tr>
<tr><td>SIDs:</td><td>STARs:</td><td>APCHs: enabled by existing approaches</td></tr>
<tr><td colspan="3">Additional Comments: This proposal has also been identified as an Industry priority by the PBN NIWG and in the Barriers to EoR Report.</td></tr>
<tr><td>[21] BNA – A-RNP approaches
Proponent: Southwest</td><td colspan="2">Add A-RNP procedures to enable EoR, increase use of RNPs and provide more flight efficiency</td></tr>
<tr><td>SIDs:</td><td>STARs:</td><td>APCHs: A-RNP for Rwy 02L/C/R
A-RNP for Rwy 20L/C/R</td></tr>
<tr><td colspan="3">Additional Comments: This proposal has also been identified as an Industry priority by the PBN NIWG and in the Barriers to EoR Report.</td></tr>
<tr><td>[22] JFK – Approaches to Rwys 13L/R
Proponent: JetBlue</td><td colspan="2">Adjustments to approaches for 13L/R to enable EoR, increasing arrival throughput</td></tr>
<tr><td>SIDs:</td><td>STARs:</td><td>APCHs: Modify to meet criteria –
RNP AR Rwy 13L
RNAV (GPS) 13L</td></tr>
<tr><td colspan="3">Additional Comments: This proposal has also been identified as an Industry priority by the NEC NIWG.</td></tr>
</table>

PBN Proposal Descriptions (continued)

[23] ATL – RF/TF overlay with xLS Proponent: Delta	RF/TF overlay authorization and xLS transitions to increase use of RNP procedures and added efficiency	
SIDs:	STARs:	APCHs: RNAV (RNP) 08L RNAV (RNP) 10 RNAV (RNP) 26R RNAV (RNP) 28
Additional Comments: Include a TF "overlay" of the downwind turn transition on the RF RNAV (RNP) approaches, similar to application in Las Vegas Metroplex (south downwind), increasing use of the current curved path procedures. Applies to both the ILS and the RNAV (GPS) approaches to the outboard runways (10/28 and 8/26). The RNAV (RNP) approaches may become A-RNP to RNAV (GPS) approaches. Two options for consideration: a true overlay procedure on an RNAV procedure with both RF and TF turns, or a new approach in conjunction with the current RNAV RNP to either RNAV procedures or the ILS; whichever works best for ATC.		
[24] DFW – Offload RNAV STAR for NE corner Proponent: American	Develop an Offload RNAV STAR for the NE corner post to service Rwy 17L/35R	
SIDs:	STARs: New Offload STAR from NE corner post	APCHs:
Additional Comments: NE corner is the busiest corner for DFW traffic - PDARS data shows extensive vectoring in this sector prior to the STAR. Requesting an ATC assigned offload STAR when the airport is in a North flow, and recommend the use of runway transitions to turn the aircraft onto the ILS. Would decrease distance flown by reducing vectoring and the need for fix balancing.		
[25] ORD – Optimized STARs/SIDs Proponent: United	Add efficiency by optimizing PBN and new RNAV/GLS to better use 10R/28L; SID changes to mitigate wrong direction turns	
SIDs: Modify existing RNAV SIDs	STARs: Modify existing RNAV STARs	APCHs: RNAV (RNP) Rwy 10R/18L
Additional Comments: Modifications to STARs support continuing OPDs into TRACON airspace. Focus on heaviest used STARs to maximize benefits. Vertical optimization in C90 airspace enabling higher profiles. For SID changes, issue is created by confusing vector off the ground instructions. RNAV SID may address tower concerns.		
[26] PHX – Offload RNAV STAR for NE corner Proponent: American	Increase throughput by creating an additional offload STAR from the NE to improve traffic management for the busiest corner post for PHX	
SIDs:	STARs: new offload STAR from NE	APCHs:
Additional Comments: EAGUL OPD STAR accounts for approximately 35% of all PHX turbojet arrivals. Up to 25% of that traffic may be routed to this proposed offload procedure. Design would leverage previously developed by Metroplex Study Team.		
[27] EWR/TEB – MARS application Proponent: United, NBAA	MARS arrival-arrival application to deconflict EWR/TEB using TEB6 RNAV transition that is parallel to EWR ILS 11	
SIDs:	STARs:	APCHs: enabled by existing procedures
Additional Comments: This proposal has also been identified as an Industry priority by the NEC NIWG.		
[28] DCA – RNAV (RNP) for Rwy 01 Proponent: Southwest	Enhance safety and access by developing RNAV (RNP) Runway 01	
SIDs:	STARs:	APCHs: RNAV (RNP) Rwy 01

PBN Proposal Descriptions (continued)

[29] MEM – xLS transitions and A-RNP to all runways Proponent: FedEx	Added efficiency with xLS transition from STARs, and address unstable approaches with RNP AR or A-RNP to all runways	
SIDs:	STARs: CONDR HOBRK	APCHs: RNAV (RNP) Rwy 27 RNAV (RNP) Rwy 36L/C RNAV (RNP) Rwy 18L/C/R A-RNP for all runways
Additional Comments: Procedures found in IFP Gateway production plan. Requesting approach transition from the STAR to the ILS or any IAP including an A-RNP to a runway.		
[30] DAL/DFW – MARS application Proponent: Southwest	MARS arrival to arrival application to deconflict DAL/DFW/ADS using RNP approaches in DAL proposal	
SIDs:	STARs:	APCHs: proposed DAL procedures
[31] PHL – RNAV (GPS) for Rwys 09L/R Proponent: American, UPS	Night-time river approach for arrivals to 09L/R to add efficiency and address noise concerns	
SIDs:	STARs:	APCHs: RNAV (GPS) Rwy 09L/R
[32] DCA – CLIPR/DEALE optimization Proponent: American	Optimize existing CLIPR and DEALE STARs, building more efficient paths	
SIDs:	STARs: CLIPR DEALE	APCHs:
[33] SEA – RNAV STARs and RNPs from east Proponent: Alaska	Address delays and inefficiencies with repeatable RNAV STARs and RNP transitions from east, and enhance EoR operations	
SIDs:	STARs: RNAV for east side	APCHs: RNAV (RNP) for east side
[34] HOU – RNAV (RNP) for Rwys 13R, 31L, 22, 04 Proponent: Southwest	RNAV (RNP) Approaches to Rwys 13R, 31L, 22, and 4 to reduce fuel use and increase flight efficiency	
SIDs:	STARs:	APCHs: RNAV (RNP) Rwy 13R RNAV (RNP) Rwy 31L RNAV (RNP) Rwy 22 RNAV (RNP) Rwy 04
[35] SLC – Curved approach for Rwy 35 Proponent: Delta	Replace LDA with curved path approach for Rwy 35, providing vertical guidance to runway end	
SIDs:	STARs:	APCHs: RNAV (RNP) Rwy 35 or RNAV (GPS) EVS Rwy 35
Additional Comments: Request includes Extended Visual Segment (EVS) and an approach with TF turns in the FAS.		

PBN Proposal Descriptions (continued)

[36] SLC – RF/TF overlay for xLS Proponent: Delta	Enhanced safety, throughput and fuel efficiency for downwind ops with RF/TF overlay and xLS, enables independent simultaneous operations and future EoR operations.	
SIDs:	STARs:	APCHs: RNP for Rwy 16L/R RNP for Rwy 34L/R
Additional Comments: Request is for RNAV (RNP) with overlay TF transitions to ILS and RNAV (GPS); similar to application in Las Vegas Metroplex. The RNAV (RNP) approaches may become A-RNP to RNAV (GPS) approaches. Two options for consideration, similar to ATL RF/TF proposal (see #23 above).		
[37] SFO – GLS applications/ procedures Proponent: United	GLS to provide precision approaches to non-ILS runways: 19R, 10L/R	
SIDs:	STARs:	APCHs: GLS overlay RNAV (GPS) Rwy 19L GLS overlay RNAV (GPS) Rwy 19R GLS overlay RNAV (GPS) Rwy 28L GLS overlay RNAV (GPS) Rwy 28R
Additional Comments: Procedures found in IFP Gateway production plan. Proposal also included in Oct 2018 PBN NIWG Rolling Plan.		
[38] SFO/OAK – MARS application Proponent: United	MARS arrival-arrival applications to deconflict SFO and OAK, ensuring schedule reliability	
SIDs:	STARs:	APCHs: enabled by existing procedures
[39] FLL – RNP approaches Proponent: JetBlue, Southwest	RNP procedures to provide flight efficiency and enable EoR (follow-on to Metroplex)	
SIDs:	STARs:	APCHs: previous RNP designs
Additional Comments: For consideration toward end of mid-term (after 2023). Not intended to disrupt ongoing environmental review for Metroplex procedures. Assumed independent value from procedures under review.		
[40] BOS – RNP AR for Rwy 22L with GPS overlay Proponent: JetBlue	Address community concerns and add efficiency with 22L RNP AR approach with GPS overlay (associated with MIT/FAA/MassPort study)	
SIDs:	STARs:	APCHs: RNP AR for Rwy 22L and RNAV (GPS) overlay
[41] MCO – RNP approaches Proponent: JetBlue, Southwest	RNP procedures to provide flight efficiency and enable EoR (follow-on to Metroplex)	
SIDs:	STARs:	APCHs: previous RNP designs
Additional Comments: For consideration toward end of mid-term (after 2023). Not intended to disrupt ongoing environmental review for Metroplex procedures. Assumed independent value from procedures under review.		
[42] EWR – .308 procedures for parallel operations Proponent: United	Add .308 operations for close parallels to increase throughput	
SIDs:	STARs:	APCHs: enabled by existing procedures
Additional Comments: This proposal has also been identified as an Industry priority by the NEC NIWG.		

PBN Proposal Descriptions (concluded)

[43] SFO – .308 procedures for Rwys 19L/R operations Proponent: United	Add .308 procedures to Rwy 19L/R operations to increase throughput, using existing approach procedures.	
SIDs:	STARs:	APCHs: enabled by existing procedures
Additional Comments: Wake turbulence separation and approved vertical guidance are required for 7110.308 operations (consistent with 7110.308 Appendix A).		
[44] EWR – GLS applications/ procedures Proponent: United	Increase access with GLS approaches leveraging PANYNJ investment, e.g. curved path approach for GLS to Rwy 11	
SIDs:	STARs:	APCHs: new/modified GLS procedures
Additional Comments: Proposal also included in Oct 2018 PBN NIWG Rolling Plan.		
[45] LGA – GLS applications/procedures Proponent: Delta	Increase access with GLS approaches leveraging PANYNJ investment, e.g. improved minima through GLS with vertical guidance	
SIDs:	STARs:	APCHs: overlays for: ILS 22, ILS 04, ILS 13, LOC 31
Additional Comments: Proposal also included in Oct 2018 PBN NIWG Rolling Plan.		
[46] JFK – GLS applications/ procedures Proponent: JetBlue	Increase access with GLS approaches leveraging PANYNJ investment, e.g. straight-in approach to Rwy 22 with lower minima	
SIDs:	STARs:	APCHs: GLS overlays for each runway end (Rwys 13L/R, Rwys 22L/R, Rwys 31L/R, Rwys 04L/R)
Additional Comments: Procedures found in IFP Gateway production plan. Proposal also included in Oct 2018 PBN NIWG Rolling Plan.		
[47] IAH – GLS applications/procedures Proponent: United	Increase access with curved path options leveraging GLS	
SIDs:	STARs:	APCHs: new GLS procedures
[48] ATL – GLS applications/procedures Proponent: Delta	Increase access with GLS component added to approaches, provides single approach path in all weather	
SIDs:	STARs:	APCHs: new GLS procedures

Appendix E: Acronyms

AOPA	Aircraft Owners and Pilots Association
APCH	Approach
AR	Authorization Required
A-RNP	Advanced RNP
ATC	Air Traffic Control
ATMC	Air Traffic Management Council
COVID	Coronavirus
DME	Distance Measuring Equipment
EFVS	Enhanced Flight Vision Systems
ELSO	Equivalent Lateral Spacing Operations
EoR	Established on RNP
FAA	Federal Aviation Administration
FMS	Flight Management System
GLS	Ground Based Augmentation System Landing System
GPS	Global Positioning System
IFP	Instrument Flight Procedures
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IRU	Inertial Reference Unit
LPV	Localizer Performance with Vertical guidance
MARS	Multiple Airport Route Separation
MCL	Minimum Capabilities List
MON	Minimum Operating Network
NAC	NextGen Advisory Committee
NACSC	NextGen Advisory Committee Subcommittee
NAS	National Airspace System
NAV	Navigation
NBAA	National Business Aviation Association
NIWG	NextGen Integration Work Group
NSG	Navigation Service Group
PARC	Performance Based Operations Aviation rulemaking
PBN	Performance Based Navigation
PNT	Position, Navigation and Timing
RAA	Regional Airline Association
RF	Radius to Fix
RNAV	Area Navigation
RNP	Required Navigation Performance
Rwy	Runway
SID	Standard Instrument Departure
SME	Subject Matter Expert
STAR	Standard Terminal Arrivals
TBO	Trajectory Based Operations
TF	Track to Fix
TOC	Tactical Operations Committee
VMC	Visual Meteorological Conditions
VNAV	Vertical Navigation
VOR	Very High Frequency Omni-Directional Range
xLS	ILS/GLS/LPV

Appendix F: PBN Clarification Ad Hoc Team Participants

Ad Hoc Team Members	Organization
Steve Brown	NBAA
Brian Townsend	American Airlines
Bill Whyte	RAA

FAA Subject Matter Experts	Organization
Clark Desing	Air Traffic Mission Support
Wendy O'Connor	Air Traffic Operations
Aaron Wilkins	Air Traffic Program Management Office