Performance Based Navigation (PBN)

National Airspace System (NAS)

Navigation Strategy 2016-2030

Presented to: **Aeronautical Charting Forum**

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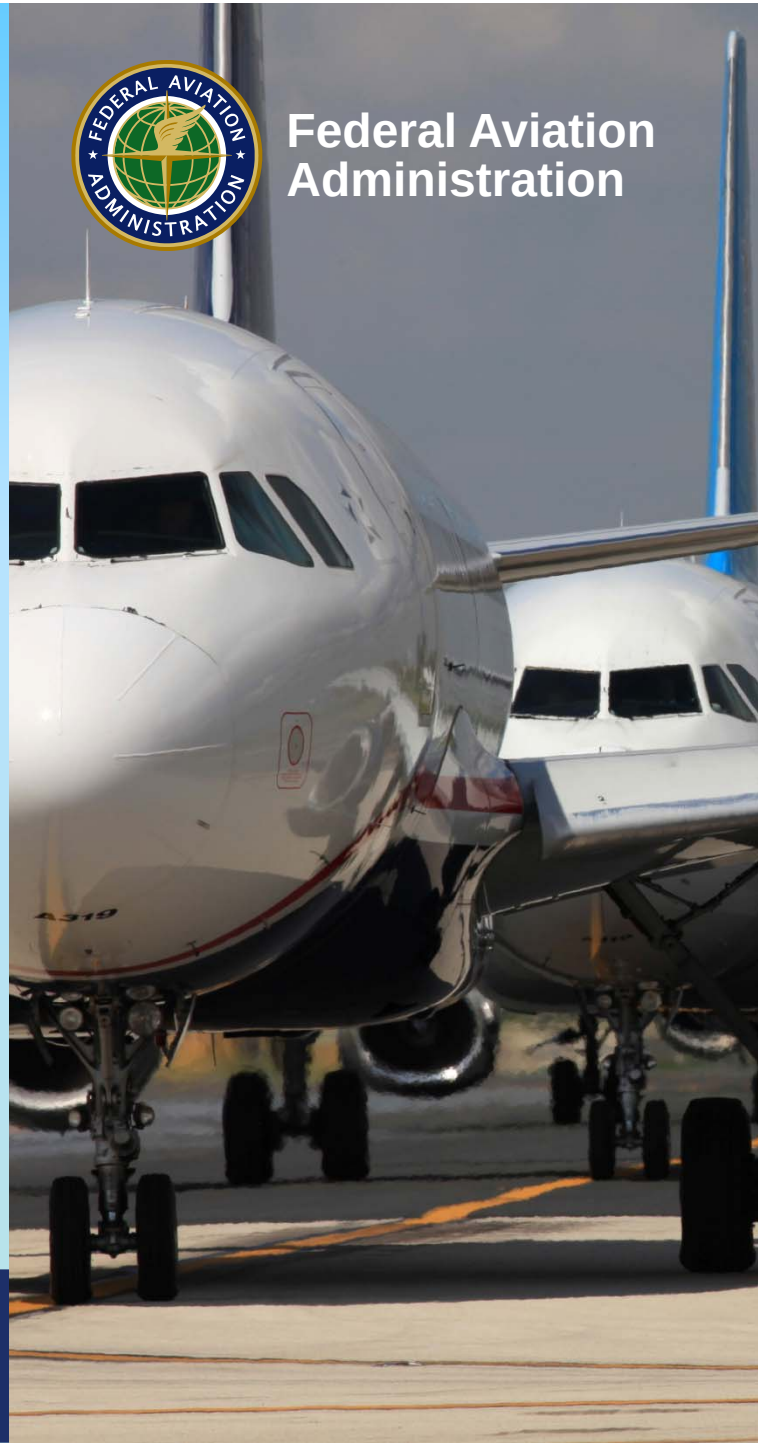


Background

- *“PBN services are laying the foundation for the NAS of the future by enabling many Next Generation Air Transportation System (NextGen) operational improvements, capabilities, and initiatives”.*

- *“It is now possible for aircraft to leverage PBN during all phases of flight, navigating free of the constraints previously imposed by the physical location of ground-based navigation infrastructure”.*

- “*The Federal Aviation Administration (FAA) has deployed many Performance-Based Navigation (PBN) procedures and routes throughout the National Airspace System (NAS) over the past 12 years, and aviation stakeholders are realizing benefits in the current environment”.*

- *“This updated PBN NAS strategy provides a compelling view of the future by building upon past PBN accomplishments and provides the context for defining and refining implementation plans and resource requirements necessary to fully transition to a PBN-centric NAS”.*

PBN NAS Navigation Strategy

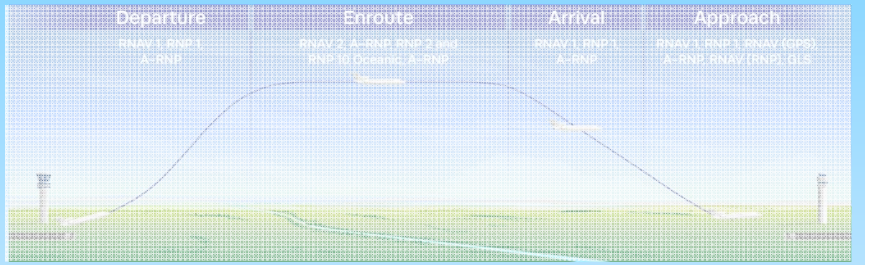
This strategy has been briefed and endorsed by the following:

- **NextGen Advisory Committee (NAC)**
- **PBN Aviation Rulemaking Committee (PARC)**
- **Communication, Navigation and Surveillance (CNS) Task Force**

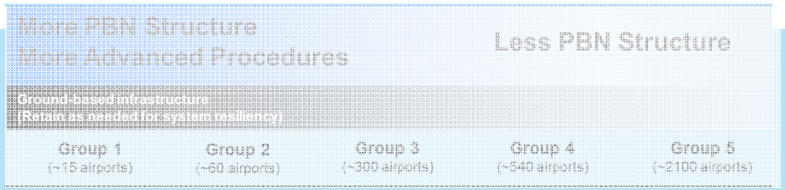
PBN NAS Navigation Strategy

Key Elements

- **Clear vision of PBN as the basis for daily operations at all locations in the NAS**
- **Identification of the key navigation capabilities that will be available in the NAS over the next 15 years**
- **Defined service groups for navigation capabilities**
- **Expectations for evolution of operator capabilities**



Near-Term (2016-2020) *Increase Utilization*	Mid-Term (2021-2025) *Streamlining Service Delivery*	Far-Term (2026-2030) *A Streamlined NAS*
Approach/Terminal ❑ Implement RNAV (GPS) with LPV and	Approach/Terminal ❑ Implement Vertically-guided RNAV (GPS)	Approach/Terminal ❑ Vertically-guided RNAV (GPS) approaches



	Near-Term (2016-2020)	Mid-Term (2021-2025)	Far-Term (2026-2030)
Class A Airspace	❑RNAV 2, supported by GNSS or DME/DME		
Navigation Service Group 1		❑GNSS and DME/DME navigation ❑RNAV (GPS) approach capability (LNAV/VNAV or LPV)	❑RNAV (GPS) approach capability (LNAV/VNAV or LPV)

Strategic Goals for Transitioning to a PBN-Centric NAS

- **Operate with PBN throughout the NAS, using: "The right procedure to meet the need"**
- **Use navigation structure where beneficial and flexibility where possible**
- **Shift to time and speed-based air traffic management (TBFM)**
- **Deliver and use resilient navigation services**
- **Modernize the FAA navigation service delivery to reduce delivery time**
- **Enable lower visibility access**
- **Innovate and continuously improve**

Key Commitments by Timeframe

- **Approach/Terminal**
  - Continue to deploy RNAV (GPS) approaches with vertical guidance
  - Update criteria and policies for increased access
  - Replace conventional procedures with PBN
  - DME/DME coverage at select airports
- **Enroute**
  - Replace Jet Routes with Q-Routes and flexible PBN-based point-to-point navigation
  - DME/DME coverage in Class A
- **Oceanic**
  - Expand User Preferred Routes
  - Explore reduced RNP-based separation standards
- **NAS Operations**

Near-Term (2016-2020) *Increase Utilization*	Mid-Term (2021-2025) *Streamlining Service Delivery*	Far-Term (2026-2030) *A Streamlined NAS*

Navigation Service Groups (NSG)

- **Navigation services in the NAS based on providing the appropriate PBN tool to meet a specific operational need.**
- **The Navigation Service Group (NSG) concept determines the services provided at NAS locations.**
- **An airport's role in the NAS is used as the primary basis for its assignment to one of the six NSGs.**
- **NSGs are used to describe where navigation services will be provided across NAS locations over time**

NAVIATION SERVICE GROUPS (NSG)

NSG 1 **The busiest Large Hub airports,** 15 airports. These airports would benefit from common aircraft performance capabilities to maximize capacity. These airports will have the broadest range of PBN services.

NSG 2 Remaining **Large Hub & all Medium Hub** airports, about 60 airports. These airports will also be provided with a broad range of PBN services.

NSG 3 **Small & Non-hub airports** over 300 airports. Arrival and departure operations generally require less structure, therefore reduced range of PBN services.

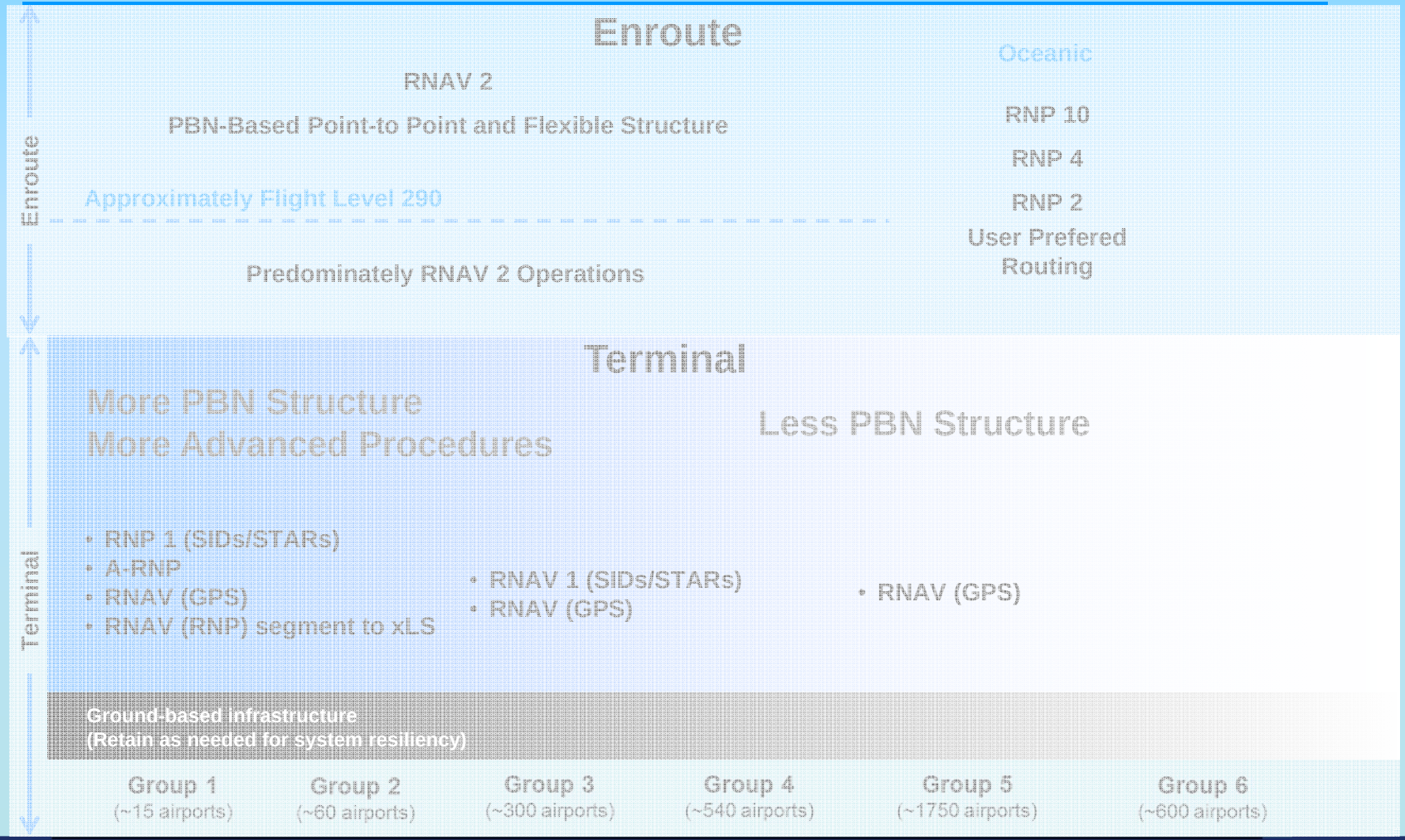
NSG 4 **National and Regional general aviation airports**, over 500 airports. Less likely to require RNAV SIDs and STARs. Some CAT I ILS and Localizer approach reduction as part of ILS Rationalization initiative.

NSG 5 **Local and Basic GA airports,** over 2,000 airports. Airports will have RNAV approaches. CAT I ILS reductions under ILS Rationalization. VOR Minimum Operational Network (MON) airports will retain ILS approaches.

NSG 6 All airports without instrument approach procedures. No PBN.

Navigation Services across Airport Groups

Summary of Availability in the Far-Term/2026-2030



Minimum PBN Capabilities Expected of Operators by Timeframe and Domain

	Near-Term (2016-2020)	Mid-Term (2021-2025)	Far-Term (2026-2030)
Class A Airspace Above FL290	❑ RNAV 2, supported by GNSS or DME/DME	❑ GNSS and DME/DME navigation	
Class A Airspace Below FL290	❑ RNAV 2, supported by GNSS or DME/DME		
Navigation Service Group 1		❑ GNSS and DME/DME navigation ❑ RNAV (GPS) approach capability (LNAV/VNAV or LPV) ❑ RNP 1 capability ❑ RF capability	❑ Required time of arrival capability
Navigation Service Group 2		❑ GNSS and DME/DME navigation	❑ RNAV (GPS) approach capability (LNAV/VNAV or LPV) ❑ RF capability
All IFR Operations		❑ Early in the mid-term, RNAV 2 and RNAV 1, supported by GNSS ❑ RNAV (GPS) approach capability (LNAV at minimum)	❑ RNAV (GPS) approach capability (LNAV/VNAV or LPV)*

Note: FAA recognizes the capabilities of specific public aircraft fleets and potential effects these have on the operation within the enroute domain.
*As conventional navigation is reduced in the far-term and beyond, the lowest available minimums may be achieved with an LPV capability.

Increasing PBN Procedure Utilization

Lessons learned from early PBN implementations reveal several important factors to maximize procedure utilization:

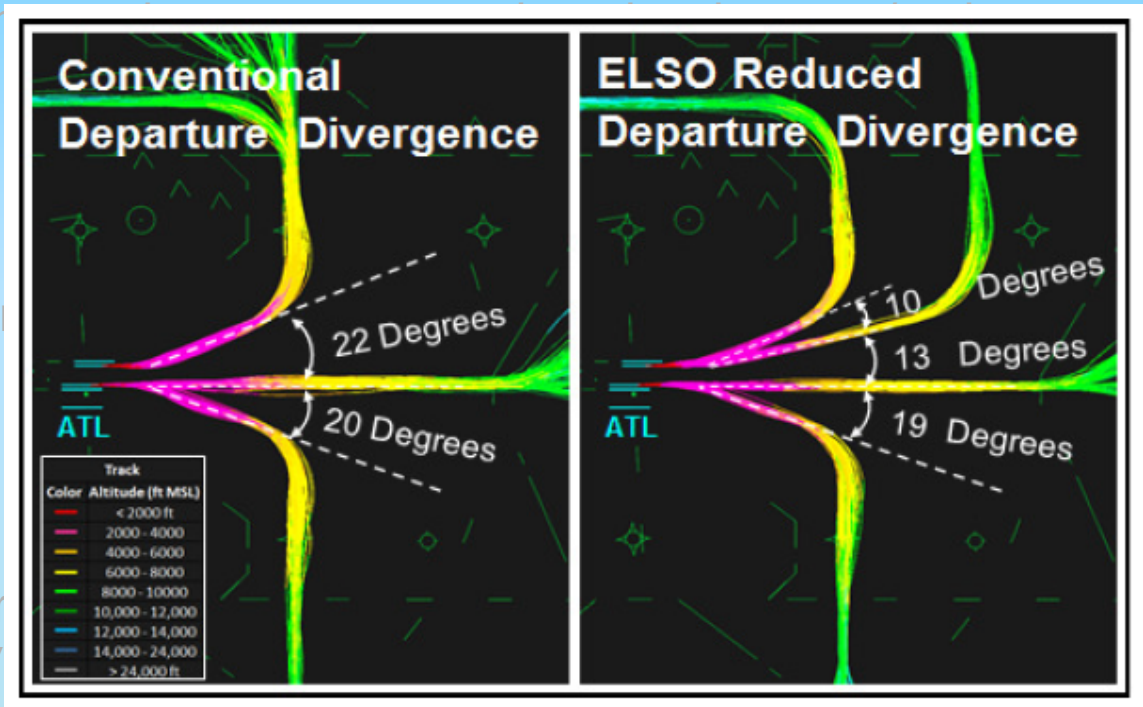
- **Balance the objectives of operational stakeholders.**
- **Integrate appropriate ATC decision support tools.**
- **Conduct comprehensive ATC and pilot training.**
- **Reduce the time to develop, implement, and amend procedures.**
- **Leverage capabilities to model and simulate airframe and avionics variations.**
- **Modify criteria and policies to make advanced concepts and services operationally available.**

Focus Areas Of NAS Modernization

- Increase in PBN instrument procedure development/maintenance.
- Decrease in conventional instrument procedure development/maintenance.
- Jet routes & Victor routes removed, Q & T routes developed.
- Conventional IAPs, SIDs, STARs replaced with PBN procedures.
- Increased development and use of hybrid procedures, i.e. RNAV/RNP to ILS
- Increased development and use of RF segments.
- Runway criteria changed to allow the addition of vertically guided operations (LPVs & VNAVs) at locations not qualifying today.

Focus Areas Of NAS Modernization

- Increase i… …e.
- Decrease … …aintenance.
- Jet routes …
- Conventio… …s.
- Increased … …/RNP to ILS
- Increased …
- Runway cr… …d operations (LPVs & V…



- Increased application of Equivalent Lateral Spacing Operations (ELSO) for departures.

Focus Areas Of NAS Modernization

EFVS

Enhanced Flight Vision Systems

- Increase in PBN instrument pro… …velopment/maintenance.
- Decr… …ance.
- Jet r…
- Conv…
- Incre… …P to ILS
- Incre…
- Runw… …rations (LPV…
- Incre… …O) for depa…

EFVS Image — Outside View

- Lower visibilities for approaches, using **Enhanced Flight Vision (EFVS)** &

Focus Areas Of NAS Modernization

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- Increased developm...
- Runway criteria cha... lly guided operations (LPVs & VNAVs) at...
- Increased applicatio... erations (ELSO) for departures.

SVGS

Synthetic Flight Vision System

- Lower visibilities for approaches, using Enhanced Flight Vision (EFVS) & **Synthetic Vision Guidance System (SVGS)**.