Performance Based Navigation:
Area Navigation (RNAV) and Required Navigation Performance (RNP)

Presented to: EWG Ops SC
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FAA RNAV/RNP Group
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Current PBN Implementation in NAS

RNAV 1 SID
RNAV 2 Q Routes & T Routes
RNAV 1 STARs
RNAV (GPS) Approaches ~ ICAO RNP APCH and RNP SAAAR = ICAO RNP AR APCH
## RNAV/RNP Accomplishments and Plans

<table>
<thead>
<tr>
<th>Description</th>
<th>FY05-07</th>
<th>FY08</th>
<th>FY09 Projected</th>
</tr>
</thead>
<tbody>
<tr>
<td>RNAV T/Q-Routes and GPS MEAs</td>
<td>69</td>
<td>49</td>
<td>12</td>
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<tr>
<td>RNAV SIDs/STARs</td>
<td>172</td>
<td>78</td>
<td>50</td>
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<tr>
<td>RNP SAAAR</td>
<td>75</td>
<td>63</td>
<td>50</td>
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<td>Helicopter RNAV (GPS)</td>
<td>5</td>
<td>-</td>
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<td><strong>Total</strong></td>
<td><strong>321</strong></td>
<td><strong>190</strong></td>
<td><strong>112</strong></td>
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**Note:** FY09 projections are subject to change based on ongoing assessments and regulatory processes.
FAA’s Detailed Evolution Plans for Specific Capabilities and Applications

- FAA and industry collaborative initiative
- Signed July 2006
- Sets implementation goals for near, mid and far term
- Integral part of NextGen
- Key of PBN
  - Area Navigation (RNAV)
  - Required Navigation Performance (RNP)
Performance Based Navigation

All Flight Domains

Current Ground Nav aids

Limited Design Flexibility

RNAV

Waypoints

Increased Airspace Efficiency

RNP

Seamless Vertical Path

“curved” paths

Highly Optimized Use of Airspace

Today

NextGen

Moving Toward: Performance Based Navigation

Ground-Based Primary Navigation

Satnav Primary Navigation

RNAV and RNP

Increased Airspace Efficiency

Highly Optimized Use of Airspace

Limited Design Flexibility

“curved” paths

Seamless Vertical Path

Waypoints
Terminal and En Route Applications

ATL RNAV SIDs

Five new egress points:
- Four vs Two to North
- Three vs Two to West
- Three vs Two to East
- Three vs Two to South

DFW RNAV Route Design

YAMEL MAX 220KT
LARRN MAX 220KT
JGIRL MAX 220KT
TREXX MAX 220KT

Florida Optimization
Terminal and Enroute

Before

After

Plus Six New RNAV STARS
(MIA,FLL,BCT,PBI,MCO)

Virginia Keys Traffic
(Mostly southbound)
Example 1: Atlanta Departure Procedures Before and After

- Approx 94% of daily departures are RNAV capable
- More departure lanes and exit points to the en route airspace
- Repeatable and predictable paths
- Benefits
  - Taxi times
  - Departure Delays
  - Improved flight profiles
  - Reduced Distances
Example 1: Cont.
Dallas Fort Worth Departure Procedures Before and After

- Approx 90% IFR departures are RNAV capable
- Improved “fanning”
- Benefits
  - Taxi times
  - Departure Delays
  - Improved flight profiles
  - Reduced Distances
Example 2: PBN “Network of Procedures”
Applications for De-confliction, Optimization and Benefits

• **Network of procedures to segregate traffic flows**
  – Between arrival/departure and transitions operations
  – Between primary and satellite airport operations
  – Between City Pairs
Example 3: Procedures with Vertical Guidance

- RNAV and RNP arrival procedures with vertical guidance can provide
  - Fewer level flight segments
  - More time in reduced or idle-power descent
- Fuel burn savings to operators
- Lower aircraft emissions
- Enhanced via data analysis capabilities
  - Ongoing analysis for procedure design, modeling, and reporting for optimization and issues identification and resolution
Example 4: Implementing “Green” Procedures

- Atlantic Interoperability Initiative to Reduce Emissions (AIRE)
- Signed by FAA and EC – June 08
- Reduce aviation’s environmental footprint
- All flight segments (gate-to-gate)
  - Surface, Oceanic, Arrival
- Near term goals
  - Optimized Profile Descents (OPD)
    - Demonstration flights
    - Completed May 2008
    - Atlanta and Miami
    - Savings: Fuel (48-52 gals/ft.), CO2 (460-497 kg/ft.)
Example 5:
Infrastructure Benefits
reduced NAVAIDS and unneeded procedures

NAVAID Divestment

Locations indicate existing navigation aids, not those proposed for divestment

<table>
<thead>
<tr>
<th>Enablers</th>
<th>Today</th>
<th>RNAV</th>
<th>LPV/RNP</th>
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<tbody>
<tr>
<td>VOR</td>
<td>1,000</td>
<td>500</td>
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<tr>
<td>DME</td>
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<tr>
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<td>500</td>
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<td>ILS III</td>
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<td>70</td>
</tr>
<tr>
<td>MB</td>
<td>1,500</td>
<td>0</td>
<td>0</td>
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</table>

Number of navigation aids is approximate
Assessing Fleet Readiness for PBN
Analysis of Equipage for PBN Procedures: 2008
Capability Report

- Current capability
  - Proprietary inventory of fleet equipage for RNAV and RNP
  - Knowledge of flight crew abilities
  - Analysis capabilities:
    - Airport-specific (OEP airports)
    - NAS-wide

- FAA – Now doing this for “NextGen”

- Future capability development in FY09
  - All aircraft capabilities required for NextGen.
Summary

- RNAV and RNP key building blocks of NextGen

- Addresses
  - Capacity, safety, environment, fuel, and includes infrastructure cost savings
  - Over $130M cumulative savings to operators since 2006

- Ongoing technical and operational analysis (includes propriety data), complex modeling, prototyping, and concepts development that contribute to standards development, procedures implementation, and benefits
Standard Terminal Arrival (STAR) Optimized Profile Descent (OPD) Effort
FY 09 Prioritize Implementation Sites

• Extensive operational analysis of IFR airports due 2/09

• The site specific methodology will account for airport and airspace complexities, aircraft equipage, operational benefits and environmental “hot spot” factors

• Develop site selection list and coordinate with industry partners

• Initiate new Procedure Design Activity
Existing OPD Examples

• **Published Procedures:**
  – Los Angeles (LAX) - September 08: 3 procedures provide OPD for approximately 50% of LAX traffic. Benefits analysis ongoing

  – Phoenix - 4 published RNAV STARs
    • Evaluation of ‘descend via’ from FL400 1 corner post commenced 9/22

  – Atlanta RNAV STAR OPD 90-day demo commenced in August
    • Incorporates an optimized profile on an existing RNAV STAR to enable a CDA from the en route (FL350)
    • Development of a published procedure will be pursued after the demo

• **Under Development:**
• **Charleston - Kickoff meeting July 15-17. Designed 4 OPD RNAV STARs**
  • Collaborative effort with AJP-67 (AIRE) and USAF (C-17)

  – Louisville-Standiford - Kickoff meeting June 17-18
    • Designed 7 OPD RNAV STARs
Approach Chart Comparison
Rifle, Colorado
Benefits of RNP SAAAR

- High terrain on both sides of approach path to Runway 8
- RNP SAAAR enables stabilized vertically guided approaches
- Reduces landing minima from 1900 ft / 3 miles to as low as 300 ft / 1 mile
NAS-Wide OEP Airport PBN Capability

Operations by Operator Type for OEP Airports

- **48%**
- **32%**
- **15%**
- **3%**
- **2%**

- **Major Airlines**
- **Regional Airlines**
- **Other Part 121 Airlines**
- **Cargo**
- **GA**

**PBN Capable Operations (Quarter 1 2008)**

- RNAV - 1 or RNAV - 2
- RNP - 1
- RNP - 0.3
- RNP SAAAR
- RNP SAAAR with RF
- RNP SAAAR with MA of < 1 NM

**Forecast PBN Capable Operations**

- **Forecast Year 2016**
- **Quarter 1 2008**
Questions?