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

Program Overview

Presented to:  CDA Workshop
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   RNAV and RNP Group

Date: January 19, 2006
Roadmap for Performance-Based Navigation

- The FAA published the *Roadmap* in July 2003
- Collaborative effort among aviation industry stakeholders
  - Performance-Based Operations Aviation Rulemaking Committee (PARC)
- Aligned with FAA *Flight Plan, ATO Business Plan*, OEP, and RTCA
- Updating December 2005 to reflect lessons learned
What is “Performance-Based Navigation”?

- Aviation authorities specify the aircraft capabilities and performance requirements necessary to operate in a given airspace or use a given procedure (instead of specifying required technologies or specific avionics)
  - RNAV is achieved through a combined use of aircraft navigation accuracy, route separation and/or air traffic control intervention (e.g., via radar monitoring, automatic dependent surveillance (ADS), multi-lateration, communications)
  - RNP is RNAV operations with on-board navigation containment, monitoring and alerting
Performance-Based Navigation Evolution

Conventional Routes
- Current Ground NAVAIDs
- Limited Design Flexibility

RNAV
- Waypoints
- Increased Airspace Efficiency

RNP
- Narrow TERPS
- “curved” paths
- Optimized Use of Airspace

- More complex routes
- Tighter performance
- No radar requirement
- 30% capable US fleet

- Point-to-point routes
- Radar monitoring
- 90% capable US fleet

Federal Aviation Administration
RNAV/RNP Program Overview
January 19, 2006
Performance-Based Navigation
In All Phases of Flight
“Snapshot” of Current U.S. Implementations
Enabling Criteria, Guidance and Tools

- Part 75 Revision for RNAV routes
- AC 90-100
  - US Terminal and En Route Area Navigation (RNAV) Operations
- Order 7470.1
  - DME/DME Evaluation
- Order 8260.44A
  - Civil Utilization Of Area Navigation (RNAV) Departure Procedures
- RNAV-PRO DME Screening Tool
- TARGETS development tool
- Order 8260.53
  - United States Standard for Instrument Departures that use Radar Vectors to Join RNAV Routes
- AIM Revisions for RNAV
- Charting Specifications for RNAV routes and procedures
- Notice 8000.302
  - Stand-Alone Area Navigation (RNAV) Transition Procedures
Enabling Criteria, Guidance and Tools (Completed)

• AC 90-96A
  – Approval of U.S. Operators and Aircraft to Operate Under Instrument Flight Rules (IFR) in European Airspace Designated for Basic Area Navigation (B-RNAV) and Precision Area Navigation (P-RNAV)

• AC 20-153
  – Acceptance of Data Processes and Associated Navigation Databases

• Notice 8000.300

• Order 8260.52
Enabling Criteria, Guidance and Tools (Completed)

- US RNP SAAAR Criteria (FAA Order 8260.52) was submitted to the ICAO OCP as a model for international criteria for RNP approach procedures
  - OCP accepted the order in total
    - A drafting group will adapt the order to be consistent with PANS-OPS
    - Intent is to publish this criteria as a stand-alone document supplementing PANS-OPS
      - The end state objective is to have mature criteria for introduction into PANS-OPS at OCP/15 in the fall of 2007
- AC 90-101
  - Approval for RNP procedures with Special Aircraft and Aircrew Authorization Required (SAAAR)
FY2005 Highlights

• Published 6 RNP Special Aircraft and Aircrew Authorization Required (SAAAR)
  – 1 public RNP SAAAR
  – 4 special RNP SAAARs
  – 1 special RNP Parallel Approach Transition (RPAT)

• Published/Implemented 25 RNAV Routes
  – 21 high altitude (Q-Routes)
  – 4 low altitude (T-Routes)

• Implemented 58 Standard Terminal Arrivals (STARs) and Standard Instrument Departures (SIDs)
RNAV Departure and Arrival Procedures
Examples of Near-term Implementation

<table>
<thead>
<tr>
<th>Airport</th>
<th>Date</th>
<th>Procedure</th>
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</thead>
<tbody>
<tr>
<td>Las Vegas (America West, Southwest)</td>
<td>Nov 2004</td>
<td>4 STARs and 5 SIDs</td>
</tr>
<tr>
<td>Dulles (United, Independence Air)</td>
<td>Jan 2005</td>
<td>4 STARs</td>
</tr>
<tr>
<td>Philadelphia (US Airways)</td>
<td>March 2005</td>
<td>2 STARs</td>
</tr>
<tr>
<td>Atlanta (Delta)</td>
<td>April 2005</td>
<td>4 STARs 13 SIDs</td>
</tr>
<tr>
<td>Dallas Fort Worth (American)</td>
<td>September 2005</td>
<td>16 SIDs</td>
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Atlanta RNAV Departure Procedures
April 2005

- Approx 90% of 1350 daily IFR departures are RNAV capable
- Structured “lanes” to en route airspace
- Over 4,000 routine daily pilot/controller voice transmissions eliminated (30% reduction)
- Delta Airlines estimates $30M annual savings
  - Decreased taxi times
  - Decreased departure delays
  - Improved flight profiles
  - Reduced distances
RNP SAAAR Approach Criteria

Enabling Features

Narrow lateral linear segments
*(RNP-0.3 or less with no secondary buffers)*

Curved segments anywhere along the approach
*(Radius-to-fix legs with shorter leg lengths)*

Guided, narrower turns on missed approaches
*(Radius-to-fix legs, and RNP-1 or less)*

Performance-based Vertical Profiles
*(Vertical Error Budget vs. Barometric Vertical Nav)*

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**STEP 1:** Segment Initial Fix

**STEP 2:** Locate Turn Center

**STEP 3:** Tangent Points

**STEP 4:** Curve Segments

**STEP 5:** Narrow Segments

Vertical Profiles & Missed Approach
RNP SAAAR Approach Applications and Priorities
Analysis of Top 100+ Airports

<table>
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<tr>
<th>Airports</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>Tier 1</td>
<td>• Near-term capacity needs, with national impact</td>
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<tr>
<td></td>
<td>• Safety enhancement applications</td>
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<tr>
<td>Tier 2</td>
<td>• Regional capacity impact</td>
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<tr>
<td></td>
<td>• Access &amp; safety enhancements</td>
</tr>
<tr>
<td>Tier 3</td>
<td>• Single runway access and safety enhancement</td>
</tr>
<tr>
<td></td>
<td>• Future airspace de-confliction</td>
</tr>
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</table>
Palm Springs RNP Approach
January 2005

- Avoids non-precision approach into a valley with mountainous terrain
- Safety enhancement, with guided, stabilized 3D path to runway
- Reduced time & distance (approximately 30 miles)
- Reduced minima, averting cancellations & diversions

- 20 flights “saved” in first few weeks of implementation
- A SAVE is a flight that would have been canceled or diverted if the RNP procedure was not available
International Harmonization and Coordination

Airspace Issues
Environment
Standards & Criteria
Procedure Design
Implementation

Coordination & Harmonization

Seminars and Workshops
Standards & Criteria
Procedure Design
Implementation
International

- **Work with ICAO and EUROCONTROL on international standard for RNAV and RNP**
  - ICAO RNP Study Group agreed to move forward single ICAO RNAV standard (AC90-100, TGL10)
    - Revise RNP Manual (Doc 9613)
- **Support international harmonization**
  - North American Aviation Trilateral (NAAT)
    - Signed *Joint Strategy for Implementation of Performance-Based Navigation in North America*
      - FAA, Transport Canada, DGAC Mexico, NAV CANADA, and SENEAM
  - Departamento de Controle do Espaço Aéreo (DECEA) (Brazil)
  - Asia-Pacific Economic Cooperation (APEC)
  - European Organisation for the Safety of Air Navigation (EUROCONTROL)
  - Japan Civil Aviation Bureau (JCAB)
  - Civil Aviation Authority of China (CAAC)
  - Caribbean/South American (CAR/SAM) Regional Planning and Implementation Group (GREPECAS)
Flight Standards “Special” Approval Process

• Waiting on slides from Les