Required Navigation Performance (RNP) in the United States

Presentation: FAA Roadmap for Performance-Based Navigation
Moving to Performance-Based Navigation (RNAV and RNP)
Definitions
Operational attributes of RNP SAAAR approaches
Benefits of RNP SAAAR approaches
Initial Implementation in the U.S.
FAA Guidance Documents for RNP

Overview

FAA’s Roadmap for Performance-Based Navigation

- Collaborative effort among aviation industry stakeholders
  - Performance-based Operations Aviation Rulemaking Committee (PARC)
- Aligned with the Operational Evolution Plan (OEP) and FAA Flight Plan
  - Near-term 2003 to 2006
  - Mid-term 2007 to 2012
  - Far-term 2013 to 2020
- Focuses on operational capabilities in:
  - En route domain
  - Terminal domain
    - Standard Terminal Arrivals (STARs)
  - Standard Instrument Departures (SIDs)
  - Approach domain


US Leadership: International Interest in the US RNAV and RNP Initiatives

Moving To Performance-Based Navigation

- Conventional Routes
- RNAV
- RNP
- Current Ground NAV/IDs
- Limited Design Flexibility
- Increased Airspace Efficiency
- Narrow TERPS
- "curved" paths
- Optimal Use of Airways

Definition: RNP

- RNP is RNAV operations with on-board navigation containment and monitoring
- A critical component of RNP is the ability of the aircraft navigation system to monitor its achieved navigation performance, and to identify for the pilot whether the operational requirement is, or is not being met during an operation (monitor and alert)
- RNP capability of the aircraft is a major component in determining the separation criteria to ensure that the overall containment of the operation is met
  - This is a distinguishing feature of RNP
**Definition: RNP Containment**

RNP-x is aircraft path conformance (with accuracy x or better, 95% of time)

- RNP Containment Region is an area 2x RNP-x with accuracy, integrity and continuity generating a probability that aircraft is within the containment area 99.999% of the time.
- RTCA/DO-286A RNP RNAV has adopted 2x RNP as the lateral containment area.

**Definition: SAAAR**

- SAAAR: Special Aircraft and Aircrew Authorization Required
- SAAAR procedures are typically public procedures
  - Example is ILS CAT II/III
- Requires carriers to apply for approval to fly these procedures

**Operational Attributes of RNP SAAAR Approaches**

- **SAAAR Attributes**
  - Narrower lateral TERPS (e.g., RNP-0.3 or less, in secondary)
  - Guided turns/Lower RNP on missed approaches (RF and RNP-0.3 or less)
  - Curved segments anywhere along the approach (RF legs)
  - Reduced obstacle clearance (VEB – Vertical Error Budget)
  - "not all attributes are required for every approach procedure"

**Benefits of RNP SAAAR Approaches**

- Provides better access through lower minimums to runways with terrain/obstacles
- Increases use of under-utilized runways (parallel, converging, standalone)
- Improves backup procedures during ILS outages
- De-conflicts airspace and traffic flows (e.g., converging runways, adjacent procedures) through narrower and curved segments
- Improves safety by eliminating circling maneuvers and providing guidance to the runway
- Simplifies pilot training by eliminating NPAs without sacrificing access

**RNP SAAAR Approach Implementation: An FAA National Initiative**

- Implementation concept
  - Initial 10 projects developed as “Special” procedures using FAA Notice 8000.287
  - Implementation is in partnership with a lead carrier for each site
  - FAA Notice 8000.287 provides
    - Procedure development criteria
    - Aircraft evaluation requirements
    - Operator approval requirements
- Initial 10 projects to be converted to public procedures when "public criteria" published
  - Public criteria finalized in FAA Order 8260 RNP SAAAR
  - Once public, procedures remain SAAAR (similar to ILS CAT II/III)
  - Aircraft evaluation and Operator approval requirements being published in Advisory Circular (AC) 90 RNP SAAAR

**FAA Guidance Documents for RNP Approaches**

- **FAA Notice 8000.287 AIRWORTHINESS AND OPERATIONAL APPROVAL FOR SPECIAL-REQUIRED NAVIGATION PERFORMANCE (RNP) PROCEDURES WITH SPECIAL AIRCRAFT AND AIRCREW AUTHORIZATION REQUIRED (SAAAR)**

  Coming Summer 2005:
  - FAA Order 8260, RNP SAAAR* UNITED STATES STANDARD FOR REQUIRED NAVIGATION PERFORMANCE (RNP) APPROACH PROCEDURES WITH SPECIAL AIRCRAFT AND AIRCrew AUTHORIZATION REQUIRED (SAAAR)
  - FAA AC 90-RNP SAAAR* APPROVAL FOR REQUIRED NAVIGATION PERFORMANCE (RNP) PROCEDURES WITH SPECIAL AIRCRAFT AND AIRCrew AUTHORIZATION REQUIRED (SAAAR)

*Final Draft
RNP SAAAR Approach - KJFK Example

- Reduced minimum (1800 ft vs. 4000 & 2 ft)
- Lateral and Vertical Guidance
- Encroachment with LGA

Example: 13 Atlanta RNAV SIDs Implemented on 25 April 2005

**BEFORE**
- Departures are vectored
- Headings, altitudes and speeds issued by controllers
- Large number of voice transmissions required
- Significant dispersion
- Tracks are inconsistent and inefficient
- Limited exit points

**AFTER**
- Departures fly RNAV tracks (not vectored)
- Headings, altitudes and speeds are automated (via avionics)
- Voice transmissions reduced by 30-50%
- Reduced Track Dispersion
- Tracks are more consistent and more efficient
- Additional exit points available

Palm Springs RNP SAAAR Approaches (31L, 13R)

(January 2005)

- Replaces non-precision approach into the valley with mountainous terrain
- Safety enhancement, with guided, stabilized 3D path to runway
- Reduced time & distance (30-40 miles)
- VOR or GPS B’ minima is 2300 - 3
- RNP SAAAR minima 684 - 1
- Concatenations and diversions avoided
- 24 flights diverted/cancelled in 6 weeks before implementation
- 20 “SAVES” since implementation
- A “SAVES” is a flight that would have been cancelled or diverted if the SAAAR procedure were not available

Terminal Procedures (STARs, SIDs)

**Benefits**
- Increased arrival/departure throughput and efficiency
- Increased predictability
- Decreased departure delays
- Decreased taxi times
- Reduced track distances
- Reduced voice communications & vectoring
- More efficient vertical profiles
- Reduced fuel consumption

Example: 13 Atlanta RNAV SIDs Implemented on 25 April 2005

**BEFORE**

**AFTER**
Q-Routes
(RNAV routes FL 180 and above)

- Radar monitoring required
- GPS Required
- Authorized for DME/DME/IRU as infrastructure supports
- Multiple routes at the same airspace
- Improved efficiency
- Fewer conflicts between routes

RNP SAAAR Approaches
Initial 10 Implementation Projects

<table>
<thead>
<tr>
<th>Site</th>
<th>Runway</th>
<th>RNP Standard</th>
<th>Package Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Houston, TX (IAP)</td>
<td>28L, 28R</td>
<td>Terminal Arees</td>
<td>in service</td>
</tr>
<tr>
<td>Miami, FL (IAP)</td>
<td>31L, 31R</td>
<td>JetBlue</td>
<td>Submitted April 08</td>
</tr>
<tr>
<td>Portland, OR (PDX)</td>
<td>26, 28R</td>
<td>Horizon Air</td>
<td>Submitted April 08</td>
</tr>
<tr>
<td>Reagan National (DCA)</td>
<td>11</td>
<td>Alaska Airlines</td>
<td>in design</td>
</tr>
<tr>
<td>Newark, NY (EWR)</td>
<td>26, 28L</td>
<td>Continental Airlines</td>
<td>Initial 10 Implementation Projects, Feb 08</td>
</tr>
<tr>
<td>Chicago O'Hare (ORD)</td>
<td>13C, 13L</td>
<td>FAA</td>
<td>Prepare a design in progress</td>
</tr>
<tr>
<td>Newark, NY (EWR)</td>
<td>26R, 28L</td>
<td>Continental Airlines</td>
<td>Initial 10 Implementation Projects, Feb 08</td>
</tr>
<tr>
<td>Philadelphia, PA (PHL)</td>
<td>77</td>
<td>US Airways</td>
<td>Initial 10 Implementation Projects, June 2012</td>
</tr>
<tr>
<td>Tampa, FL (TPA)</td>
<td>11</td>
<td>Alaska Airlines</td>
<td>Initial 10 Implementation Projects, June 2012</td>
</tr>
</tbody>
</table>

Applications of RNP SAAAR Criteria in U.S.
Preliminary Analysis at Top 100 Airports

<table>
<thead>
<tr>
<th>Parallel Operations</th>
<th>Converging Operations</th>
<th>Adjacent Airport Operations</th>
<th>Single Runway Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Top-100&quot;</td>
<td>Converging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 to 15 Top Airports</td>
<td>15 to 20 Top Airports</td>
<td>10 to 15 Top Airports</td>
<td>Several hundred runway ends</td>
</tr>
</tbody>
</table>

Arrival capacity gains up to 60% over single runway operations
Arrival capacity gains up to 55% over single runway operations
Increased arrival and departure rates for adjacent airports benefited
Approach minimums lower than existing minima

Comparison of Different Criteria Lateral Obstacle Search Areas

- LNAV
- RNP
- DA

Runway

PFA Order 8610.49
Final Order 8610.49 RNP w/Standard Missed Approach
RNP w/RNP Missed Approach
IACR/RNP Cap RNP
The Critical Elements of RNP Standards

Airspace & Procedure Design Criteria  
Operational Procedures and Equipment/System Standards

The Critical Elements Work Together

- **Airspace and Procedure Design Criteria** provide the means to:
  - Provide separation from aircraft, airspace and obstacles
  - Give airspace planners a basis to design traffic flows, arrivals, departures and landings
- **Equipment/Systems Standards** provide the means to:
  - Assess aircraft and equipment performance levels
  - Approve equipment to meet performance levels
- **Operational Procedures/Standards** provide means to:
  - Approve the methods of operation of performance levels of equipment to comply with the assumptions of the procedure design criteria

FAA Guidance Documents for RNAV

- FAA AC 90-100 U.S. TERMINAL AND EN ROUTE AREA NAVIGATION
- FAA Order 7470.1 DISTANCE MEASURING EQUIPMENT (DME)/DME INFRASTRUCTURE EVALUATION FOR AREA NAVIGATION (RNAV) ROUTES AND PROCEDURES
- FAA Order 8260.4A CIVIL UTILIZATION OF AREA NAVIGATION (RNAV) DEPARTURE PROCEDURES
- FAA AC 90-66A - 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)
- FAA AC 20-06B - ACCEPTANCE OF DATA PROCESSES AND ASSOCIATED NAVIGATION DATABASES