PBN Route Structure
Concept of Operations

Overview

Presented to: Aeronautical Charting Forum

By: Sharon Abhalter, Manager, AJV-14

Date: October, 30, 2014
PBN Route Structure CONOPs (PBN-RS)

• **Background**
  - PBN is envisioned to be the primary means of navigation across the NAS. The PBN-RS is a component of a foundational PBN network and can optimize the use of airspace in specified areas with PBN ATS route structure while providing point to point flexibility elsewhere.

• **CONOPs Scope**
  - Describes a NAS wide end-state route structure concept consisting of both PBN Air Traffic Service (ATS) routes (i.e., Q-routes, T-routes & Y routes) and point-to-point navigation.

• **Guiding principle**
  - “Structure where structure is necessary and, point-to-point where it is not.”
  - Route structure requirements will be based on factors such as traffic demand, airspace utilization, ATC task complexity, airspace access and user operational efficiencies.
Why Establish Q and T Routes

• High Altitude (Q’s)
  – Publish high altitude PBN ATS routes precisely where needed to…
    • Increase airspace capacity and reduce complexity in high volume corridors
    • Procedurally deconflict and segregate flows onto more numerous route options.
    • Improve flight path predictability in congested airspace via optimized routes
    • Retain flexibility via point to point flight path options in less congested airspace.

• Low Altitude (T’s)
  – Publish low altitude PBN ATS routes precisely where needed to…
    • Access rather than circumvent Class B/C airspace
    • Lower minimum altitudes in areas of high terrain to improve access and avoid icing
    • Circumvent Special Use Airspace in safe and optimal manner
Why establish Q and T routes

• **Rightsizing - Obsolescence of ground based navigation**
  – VHF VOR facilities support the over 1000 conventional ATS routes that crisscross the NAS today
  – Retaining a full VOR-based route structure in addition to a more optimal and dynamic PBN structure is counter-productive and wasteful due to recapitalization and maintenance costs to support the aging ground infrastructure
  – Due to reliance on ground-based structure, these routes are limited in where they can be located and contribute to system inefficiencies
  – Minimal usage and in many cases near zero usage of low altitude victor airways validate obsolescence
  • EXCEPTION: For safety purposes, legacy victors airways may be retained to provide all users navigational guidance in areas of high terrain.
Today – 699 Victor Airways
Class E airspace below FL180
## Top 100 Most Used V-Routes

### Top 81-100

<table>
<thead>
<tr>
<th>Airway</th>
<th>FY 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>V46</td>
<td>3.8</td>
</tr>
<tr>
<td>V267</td>
<td>3.7</td>
</tr>
<tr>
<td>V54</td>
<td>3.6</td>
</tr>
<tr>
<td>V312</td>
<td>3.6</td>
</tr>
<tr>
<td>V257</td>
<td>3.5</td>
</tr>
<tr>
<td>V37</td>
<td>3.5</td>
</tr>
<tr>
<td>V17</td>
<td>3.5</td>
</tr>
<tr>
<td>V292</td>
<td>3.3</td>
</tr>
<tr>
<td>V266</td>
<td>3.3</td>
</tr>
<tr>
<td>V144</td>
<td>3.3</td>
</tr>
<tr>
<td>V70</td>
<td>3.2</td>
</tr>
<tr>
<td>V187</td>
<td>3.2</td>
</tr>
<tr>
<td>V475</td>
<td>3.2</td>
</tr>
<tr>
<td>V146</td>
<td>3.1</td>
</tr>
<tr>
<td>V581</td>
<td>3.0</td>
</tr>
<tr>
<td>V68</td>
<td>3.0</td>
</tr>
<tr>
<td>V394</td>
<td>2.9</td>
</tr>
<tr>
<td>V431</td>
<td>2.9</td>
</tr>
<tr>
<td>V55</td>
<td>2.9</td>
</tr>
<tr>
<td>V317</td>
<td>2.8</td>
</tr>
</tbody>
</table>

### Average Daily Utilization: 3
Example of high usage victor airway “V2”
Anchored by 30 VOR’s, little use along most segments
Today – 301 Jet Routes
Class A airspace at and above FL180
Q Routes Implemented – 114
Clusters of short routes show low usage
T Routes Implemented - 99
High Equipage Rate Estimate for T routes
Equipage for top 20 victor airways shows 80-90% of victor airway users are equipped to fly T routes
Point to Point Navigation

• **Legacy programs have become less relevant**
  – North American Route Program (NRP)
    • Initiated 200nm from origin, terminates 200nm from dest
  – Non-restrictive routing (NRR)
    • Established or traditional “pitch” and “catch” points
  – Navigation Reference System (NRS)
    • Grid of waypoints across NAS

• **Today**
  – Users file any combination of route segments, NAVAIDs, & waypoints when not route restricted by ATC and automation

• **PBN-RS CONOPs**
  – Retire NRP and NRR
  – Work with stakeholders to place network of optimally placed waypoints
  – ATC IFR preferred routes will be primary method of communicating where route structure utilization is required. Point to point available elsewhere
Benefits of strategically placed PBN ATS Routes

- Increased # of parallel route options through high density airspace
- Reduced separation between centerlines of published routes (8nm)
- Reduction in the number of chokepoints in the system
- Establishing operational independence between air traffic flows
- Enhanced sector throughput
- Reduced propagation of delay caused by high-density airspace constraints
- Reduces controller and pilot/crew task complexity
- More optimal climbs to, descents from, and transitions through the established route structure by segregating traffic across multiple flows
- Circumnavigate Special Activity Airspace (SAAs)
- Optimally define playbook routes, CDRs, and preferred IFR routes
- Greater predictability (less variability) with block times
Case Study Examples around the NAS
Eastern Seaboard Case Study (High Altitude)
Airspace utilization, ATC complexity, operational efficiency
Notional: Segregation of CLT, DC & NY metro flows in high volume ZDC sectors

These Q-routes will also work well with an existing SID (MERIL) and two new SIDs (KILNS, BARMY) off CLT.
T Route traversing center of Atlanta Class B

Currently, aircraft traversing Atlanta’s Class B airspace receive radar vectors through a corridor extending 5nm east or west of a centerline. With T319, A80 controllers have an easy method for transitioning aircraft over the top of ATL.
Today, aircraft flying the California coast between Hunter MOA/ATCAA and W283/W532 SUAs utilize V27 and must fly at or below 7000 ft. T261 permits aircraft to fly down the coast with no altitude restrictions.
Victor Airway Retention in High Terrain
V190 across New Mexico between ABQ and Sante Fe
Heat Map of High Altitude Tracks
CONOPs Proposes 5 Regional Q Route Workgroups
CONOPs Proposes 3 T-Route Workgroups
One per Service Area
Strategic Alignment of PBN ATS Routes Development

• Central clearinghouse for establishing decision criteria and ensuring strategic alignment

• Ensures integration of NAS-wide initiatives and addresses disjointed route structure
  – Integrates Metroplex & non-Metroplex initiatives with route structure in adjacent airspace

• Removal of obsolete infrastructure
  – Supports divestment of VORs and Minimum Operation Network
  – Removal of unnecessary conventional route structure (right-sizing)

• Enabling FAA and operators to leverage investments in modern avionics
CONOPs Proposes National Workgroup
Ensures strategic alignment between 8 regional Q & T workgroups

National Workgroup Ensures Integration

5 Regional Q-Route Development Workgroups

3 T-Route Development Workgroups
Considerations for GNSS Outages

• High user equipage with DME/DME/IRU and near seamless DME/DME coverage above FL240 will support continued PBN route operations

• Network of VOR’s assumed at MON end-state will be sufficient for limited operations and provide a safe means for aircraft to land anywhere in the NAS

• Ground based airways will be retained in areas of non-radar and mountainous terrain

• Looking ahead…NextGen Alternative Positioning, Navigation, and Timing (APNT) will enable PBN operations to continue in the event of a GNSS outage
DME/DME Coverage Map FL240 & Above

Coverage per AC 90-100A (RNAV 2)
The coverage map reflects coverage as seen by a DME/DME RNAV system that minimally conforms with AC 90-100A (RNAV 2).

Legend:
- Redundant coverage (no critical facilities)
- Single critical facility
- Two critical facilities
- No coverage