National Airspace Redesign
High Altitude Redesign Briefing
for
NBAA User Forums
National Airspace Redesign

Primary means of the FAA to modernize US airspace by migrating from constrained ground-based navigation to the freedom of an RNP RNAV satellite-based system

• Collaborative effort – FAA Management & NATCA
• Bottom up: Optimize & redesign local airspace targeting congested areas …
  – Focused on key airports and associated airspace; changes in arrival and departure routes drive change up into enroute airspace

• Top down: In parallel, redesign national airspace … High Altitude Redesign (HAR)
  – By using new technology and airspace concepts, balance flexibility and structure to obtain maximum system efficiency
High Altitude Redesign

- Influenced by the airspace concepts recommended to FAA by RTCA
  - Frequent meetings with user representatives; advice on:
    - Consistency with original concepts
    - Fleet capabilities and limitations
    - Implementation impacts
- Evolutionary implementation based on emerging technology
  - Plan to begin implementing initial functions in initial airspace during 2003
  - Expansion geographically, vertically and functionally planned through 2008 and beyond
  - With each increment, benefits will increase consistent with user equipage
“...RTCA SC 192 examined the possibility of defining a high altitude airspace structure where the FAA could begin to implement many of the Free Flight concepts...

The High Altitude Airspace Concept...could provide more... freedoms...while offering an opportunity to deploy new technology and procedures in a controlled environment...

This airspace would allow properly equipped users to begin achieving the economic benefits of flying their preferred routes and altitudes with fewer restrictions...

RTCA SC 192 envisions the initial implementation of this airspace at the higher flight levels...and...at additional levels as technology and procedures allow.”
High Altitude Redesign Vision

Balance flexibility and structure to obtain maximum system efficiency

**Performance Objectives**
- Improve system efficiency
- Reduce route structure
- Eliminate “airspace” miles-in-trail restrictions
- Increase flexibility for controllers and users

**Design Objectives**
- Point-to-point navigation with pilot navigation in lieu of radar vectors
- Non-restrictive routing wherever efficient
- RNAV/parallel RNAV routes in high density corridors
- Efficient routing around active SUA/ATCAA
- Improved knowledge of SUA/ATCAA status

By ...
Evolutionary HAR Implementation

Phase 1 Initial
When: 2003
Where: Seven Northwest enroute centers at FL390 & Above

Phase 2
Provides capabilities achievable with changes to the current automation system and aircraft equipped for RVSM and RNP
When: Beginning in 2005
Where: All CONUS centers

Phase 1 Expansion
When: 2004
Where: Additional seven enroute centers in the south and southwest

Phase 1 Completion
When: 2005-06
Where: Remaining six CONUS enroute centers in the east and southeast

Phase 3
Provides benefits feasible with a new ground automation system and a digital environment
When: Beginning in 2008
Where: All CONUS centers

Phase 1 Completion includes vertical and geographic expansion. Vertical expansion will be dependent on user equipage. Geographic expansion to the northeast is dependent on completion of the Great Lakes Redesign and NY/NJ/PHL Redesign.
Phase 1 Design

Design Concept:

- RNAV / closely-spaced parallel RNAV routes
  - Using structure where most efficient
- Navigation Reference System
  - Efficiently defining flight paths – tactical and planned
- Non-Restrictive Routing
  - Providing users increased routing flexibility
- ATCAA & SUA waypoints
  - Mitigating SUA effects for civilian aviation

Enabling capability:

- Radar monitoring, RNAV/Advanced RNAV, RNP
- RNAV/Advanced RNAV & FMS data bases capacity
- URET and Navigation Reference System
- RNAV/Advanced RNAV, access to airspace schedules
Phase 1 Initial Airspace
ATS “Q” Route?

- Historically in the U. S., IFR navigation has been through a system of ground-based navigation aids using Federal Airways/Jet Routes that require pilots to fly directly toward, or away from, the NAVAID.
  - This limitation results in less-than-optimal routes, and contributes to the inefficient use of the NAS.
- Area navigation (RNAV) provides users with an ability to fly direct routes between any two points.
- FAA recently adopted International Civil Aviation Organization (ICAO) definition of “Air Traffic Service Route” as a general term to include: Federal Airway, Jet Route and RNAV route.
- The US and Canada use "Q" as a designator for RNAV routes (US 1-499/Canada 500-999).
Jet Routes

- Routes based on NAVAID Location
- Flows that cross and converge
High Altitude Q Route Examples

- Additional routes in the same airspace
- Greater efficiency
- Less confictions between routes
Q Routes and Jet Route

- Co-existing route structures increases ATC complexity
Q Routes – US/Canada

Note: Q Routes in Canada are not charted, but defined as “Fixed RNAV Routes” in Canadian Flight Supplement
Waypoints every 30 minutes of latitude, every 2 degrees longitude
NRS - CONUS Fully Populated Density

20 CONUS Centers Coverage
@ Every 10’ Latitude & 1° Longitude
Population = 6,514 points
Non-Restrictive Routing (NRR)

“Typical” filed route

“AFD” Route

“HAR”/”PTP” Route Flexibility
Example NRR “HAR” Flight
(Using NRS Waypoints)

“Catch” point

“Pitch” point

Route Flexibility
Example NRR “PTP” Flight
(Using Traditional Waypoints/Fixes)
Routing Example: Confined Airspace
HAR Weather Reroute with NRS
Sample Benefits
(Initial airspace FL390 and above)

Looking at select city pairs, average distance saving of 8 miles per flight

estimated $7M annual savings
Analytic Foundation for Decisions

- Each phase supported by modeling
  - Proof of concept modeling
  - Designs modeled for benefits and workability
- After implementation of each phase, post-analysis will:
  - Validate concept and design
  - Measure benefit
User Environment
Navigation Capabilities by Altitude*

*Updated data - 8/15/2002
Non-RNAV CY-01 to CY-02
Phase 1 Implementation “Roll Out”

May 15, 2003

Charting Waypoints
- Web access to SUA/ATCAA schedule
- ATCAA/SUA Avoidance Trials

July 10, 2003

Chart “Q” Routes
- Initial 11 Q routes rules effective and routes charted – NOTAM NA

Sept 4, 2003

- “Improved” ATCAA/SUA Web site

Sept. 23, 2003

- Initiate use of Q Routes
- Initiate NRR (PTP)

Feb. 19, 2004

Chart NRS Waypoints
- Full HAR with NRR implemented
- Point-to-point for database limited A/C
Implementation

• Advisory Circular – HAR Phase 1
  – AC in internal coordination

• SUA/ATCAA
  – Air Traffic Control Assigned Airspace (ATCAA)/ Special Use Airspace (SUA) is being depicted via Internet WEB
    • [www.faa.mil/hialt](http://www.faa.mil/hialt)
    • September 4th - release of redesigned website:
      – Improve user interface consistency with similar sites
      – Add waypoints associated with each ATCAA/SUA
      – Provide ability to filter data by altitude
    – FAA Notices 7450.1, and 7210.547 issued to support near real time ATCAA database and schedule
    – Waypoints established near SUA/ATCAA airspace to aid in avoidance of active areas
Implementation (con’t)

• Q routes - charted 7/10/03 with “GNSS Required”

• Q routes - NOTAM routes N/A to provide time to:
  – Ensure operational personnel are briefed and trained on current capabilities
  – Assess impact of RNAV and “GNSS required” decisions
  – Determine how each route will be operationally used
    • Controllers need to know which aircraft can be assigned a Q route
      – Proposing suffix changes to reflect Q route capability

• Begin flight planning of 11 Q routes at FL390 and above on September 23, 2003
  – NOTAM being revised
Implementation (con’t)

Aircraft Filing Suffix

<table>
<thead>
<tr>
<th>Filed equipment level where RNAV routes effective?</th>
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<tbody>
<tr>
<td>(varies with airspace complexity)</td>
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<table>
<thead>
<tr>
<th>ATC uncertainty of aircraft capability</th>
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<tbody>
<tr>
<td>Currently, level of aircraft capability</td>
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<tr>
<td>to use “Q” routes</td>
</tr>
</tbody>
</table>

| 100% |
| 0%   |

<table>
<thead>
<tr>
<th>/A, /P (non-RNAV)</th>
</tr>
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<tbody>
<tr>
<td>/I (Basic RNAV)</td>
</tr>
<tr>
<td>/E, /F, /R, /Q</td>
</tr>
<tr>
<td>(without GNSS)</td>
</tr>
<tr>
<td>(with GNSS)</td>
</tr>
<tr>
<td>/G (GNSS)</td>
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</table>
**Q Route Clearance by Equipment Suffix**

<table>
<thead>
<tr>
<th>Filed Suffix</th>
<th>Flight Plan</th>
<th>Tactical - Assign</th>
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<tr>
<td>A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>I</td>
<td>Q Routes or specific waypoints</td>
<td>Q Routes/waypoints*</td>
</tr>
<tr>
<td>E</td>
<td>Q Routes or specific waypoints</td>
<td>Q Routes/waypoints*</td>
</tr>
<tr>
<td>F</td>
<td>Q Routes or specific waypoints</td>
<td>Q Routes/waypoints*</td>
</tr>
<tr>
<td>R</td>
<td>Q Routes or specific waypoints</td>
<td>Q Routes/waypoints*</td>
</tr>
<tr>
<td>Q</td>
<td>Q Routes or specific waypoints</td>
<td>Q Routes/waypoints*</td>
</tr>
<tr>
<td>G</td>
<td>Q Routes</td>
<td>Q Routes</td>
</tr>
</tbody>
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* If Q routes were filed, ATC may assign another Q route; otherwise assign waypoints.
Implementation Status (con’t)

- Navigation Reference System (NRS)
  - Human Factors study
    - Part 1 – ATC assessment conducted during June with pilot observers
    - Part 2 – Pilot assessment planned for fall

- The new airspace structure charted for both users (pilots) and service providers (controllers)
  - NACO and Jeppsen have issued charts
  - Traditional waypoints and Q routes on existing charts
  - Format for depicting NRS waypoints established

- NASR database being modified with “fix usage”
Waypoint Estimates - HAR

<table>
<thead>
<tr>
<th>Phase</th>
<th>Timeframe</th>
<th>Centers</th>
<th>Pitch, Catch, SUA / ATCAA, Define Route</th>
<th>NRS</th>
<th>Cumulative Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Initial</td>
<td>CY-03</td>
<td>ZSE, ZDV, ZLC, ZOA, ZKC, ZMP, ZAU*</td>
<td>140</td>
<td>486</td>
<td>626</td>
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<tr>
<td>1 - Expansion A</td>
<td>CY-04</td>
<td>ZLA, ZAB, ZFW, ZHU, ZME, ZMA*, ZJX*</td>
<td>350</td>
<td>281</td>
<td>1,300</td>
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<tr>
<td>1 - Expansion B</td>
<td>CY-05</td>
<td>ZTL, ZDC, ZNY, ZBW, ZOB, ZID, ZAU**, ZMA**, ZJX**</td>
<td>500</td>
<td>191</td>
<td>2,000</td>
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<tr>
<td>Full U. S. w/NRS Resolution Max.</td>
<td>TBD</td>
<td>All 20 Domestic</td>
<td>1,000</td>
<td>6,500</td>
<td>7,500</td>
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Notes:
* Partial
** Remainder
Summary

• In 2003/04, the initial deployment of High Altitude Redesign will provide benefits through:
  – RNAV/Parallel RNAV routes
  – RNAV waypoint navigation around SUA/ATCAA
  – Flexibility in routing: Non-Restrictive Routing (NRR)
  – Navigation Reference System (NRS) for point-to-point navigation

• Initial affected airspace:
  – ZAU, ZMP, ZLC, ZSE, ZOA, ZDV, ZKC
  – NRR FL390 & above,
Discussion