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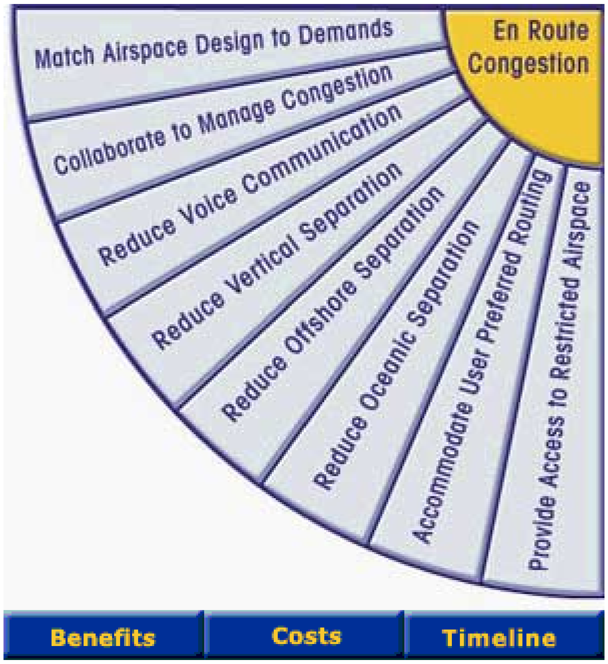
# Objective: Increased Flexibility Would Help to Isolate Problems and Avoid Gridlock




Scheduled airspace users have expressed concern at the lack of flexibility remaining in the en route segment of the system. In particular, interaction between flows with different destinations has resulted in restrictions that greatly disrupt the predictability. These interactions are tied to four limitations of today's operating environment: route structures tied to ground-based navaids; controller workload limited by manual monitoring and resolution, and limited ability to balance resources to fit demand; flow management means that are blunt; and aircraft separation standards that do not account for advances in aircraft capability.

Click on a "Wedge" to access the solution.

Related Links
Load Scenario Review Problem

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Please send your comments to nas-evol@mitre.org

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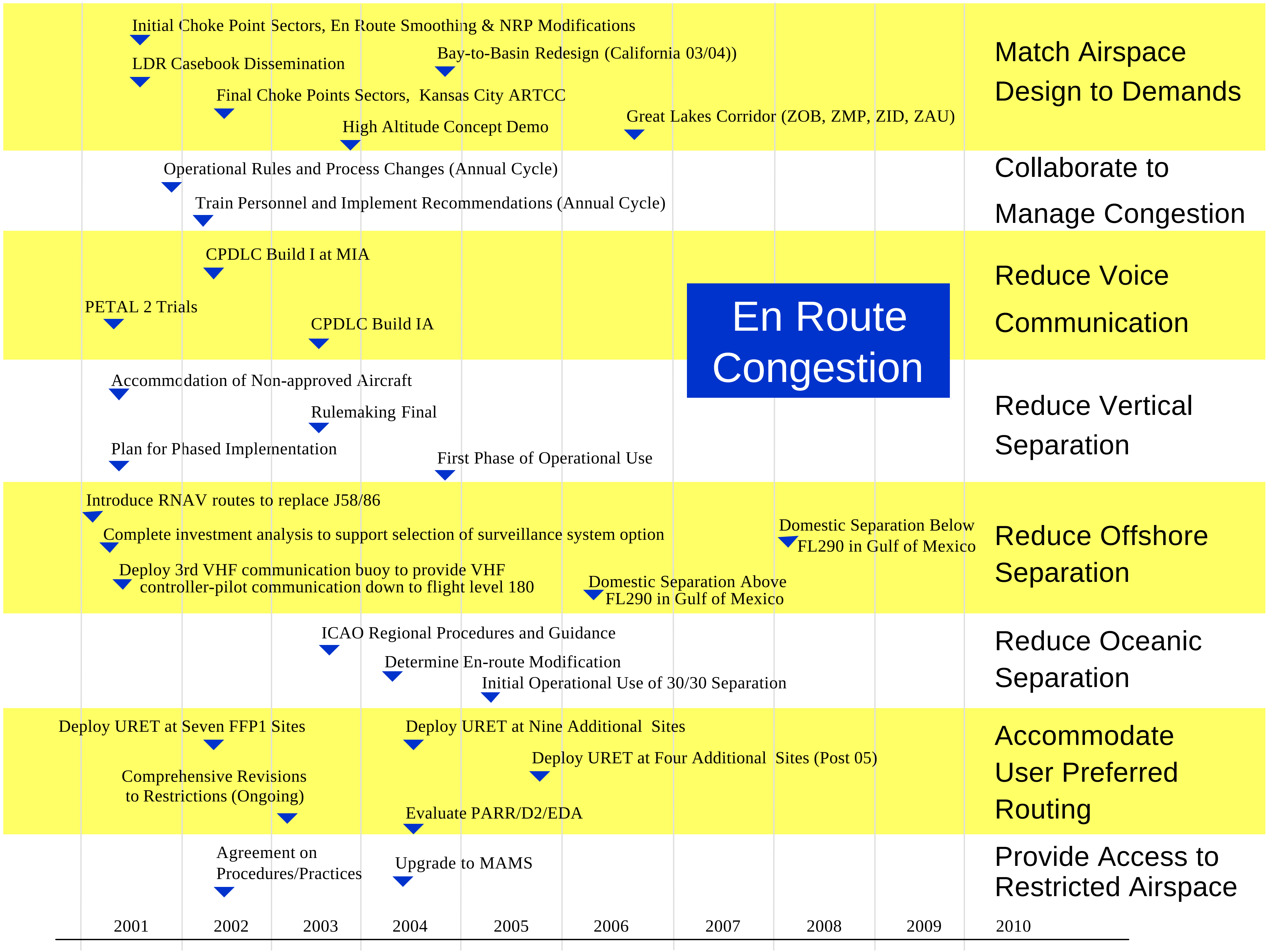
Initial Choke Point Sectors, En Route Smoothing & NRP Modifications
LDR Casebook Dissemination
Bay-to-Basin Redesign (California 03/04))
Final Choke Points Sectors, Kansas City ARTCC
High Altitude Concept Demo
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Operational Rules and Process Changes (Annual Cycle)
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CPDLC Build IA
Reduce Voice Communication
En Route Congestion
Accommodation of Non-approved Aircraft
Rulemaking Final
Plan for Phased Implementation
First Phase of Operational Use
Reduce Vertical Separation
Introduce RNAV routes to replace J58/86
Complete investment analysis to support selection of surveillance system option
Deploy 3rd VHF communication buoy to provide VHF controller-pilot communication down to flight level 180
Domestic Separation Above FL290 in Gulf of Mexico
Domestic Separation Below FL290 in Gulf of Mexico
Reduce Offshore Separation
ICAO Regional Procedures and Guidance
Determine En-route Modification
Initial Operational Use of 30/30 Separation
Reduce Oceanic Separation
Deploy URET at Seven FFP1 Sites
Deploy URET at Nine Additional Sites
Deploy URET at Four Additional Sites (Post 05)
Comprehensive Revisions to Restrictions (Ongoing)
Evaluate PARR/D2/EDA
Accommodate User Preferred Routing
Agreement on Procedures/Practices
Upgrade to MAMS
Provide Access to Restricted Airspace
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

## En Route Congestion - Benefits

The performance of the NAS depends upon the balance between capacity and demand and the geographic distribution of any imbalances. By 2010, there will be 700 to 800 more flights in the air at a given time during normal operating hours, about a 30% increase from today. En route capacity affects NAS performance through limits on traffic flows between airports. The key driver for en route capacity is the ability of the controller to direct aircraft, when needed, by vectoring traffic, changing altitudes or exercising speed control. The targeted improvements for en route airspace provide substantial reductions in interactions between flights and in communications workload, thus reducing the number of controller-to-pilot directives. Projections show airspace redesign, reduced vertical separation, RNAV routes and en route automation aids provide a 30 to 40 percent reduction in the number of interactions. The reduced number of interactions and ability of the controller to plan more strategic maneuvers through conflict prediction tools allow restrictions to be removed and lessen the impact when controllers must intervene to resolve a conflict. The savings in operating costs observed to date as part of the Free Flight program are about $18 million per year. The time savings would be about 1.8 million minutes per year based on the expansion of capabilities defined in this plan.

# Solution: Match Airspace Design to Demands



Several of the busiest sectors in the midwest and northeast United States run at or near saturation during the peak hours of the day. Distributing control of the high-demand area will reduce the chance of congestion. The distribution can be done by shifting complex airspace structures (such as holding areas) to less busy sectors, by creating additional sectors in the congested airspace, or by dynamically altering the assignment of controllers to work particular sets of traffic.

**Key Dates**

| | |
|---|---|
| Initial Choke Point Sectors, En Route Smoothing & NRP Modifications | 2001 |
| LDR Casebook Dissemination | 2001 |
| Final Choke Point Sectors, Kansas City ARTCC | 2002 |
| High Altitude Concept Demo | 2003 |
| Bay-to-Basin Redesign (California 03/04) | 2004 |
| Great Lakes Corridor (ZOB, ZMP, ZID, ZAU) | 2006 |



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# Responsible Team: Match Airspace Design to Demands

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**Primary Office of Delivery**

John Walker, ATA-1

**Support Offices**

Regional Air Traffic Managers

Regional Air Traffic Airspace and Operations Managers

Regional Airspace Focus Leadership Teams

Facility Airspace Design Teams

ATP-1

ATT-1

AUA-200

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# ER-1: Match Airspace Design to Demands

## Design and manage en route airspace to accommodate complexity and congestion.

### Background

The structure of en route airspace has stayed virtually the same for the last several decades. However, demands on this airspace have significantly increased. The number of aircraft has increased, as has the diversity in the performance and type of aircraft operating (e.g., regional jets). Programs such as the North American Route Program (NRP) and Free Flight have increased the number of aircraft flying off structured air routes. Holding areas for arrivals frequently create undesirable interactions with en route flows. In some cases, the interaction causes ground delays in order to manage increased volume in an already busy sector, and in other cases, it is a matter of contention for the same physical airspace, which results in vectoring. This holding (including no-notice holding) and the static structure of today's sectors have exacerbated congestion and complexity in the en route environment.

In the areas where congestion routinely occurs, the only means presently available to supplement current resources is to add additional sectors (through resectorization and restratification, e.g., split existing sectors). This requires floor space, sector equipment and spectrum to be available for this temporary resource. New methods for managing and applying needed resources to en route sectors are needed.

### Ops Change Description

There are four approaches proposed to deliver the desired operational change in the design and management of en route airspace:

- ER-1.1: Move holding areas that affect en route flows.
- ER-1.2: Redesign en route airspace, including adding/adjusting sector size and shape or developing rerouting options to alleviate congestion and complexity.
- ER-1.3: Implement the High Altitude Airspace Redesign.
- ER-1.4: Apply limited dynamic sectorization techniques to better manage available resources.

With regard to holding areas, the desired operational change is to make holding for the major eastern metropolitan areas of New York, Philadelphia, and Washington DC less disruptive to surrounding transition and en route operations. In the near-term, as part of the National Airspace Redesign System Choke Points, procedural and traffic management approaches are being applied to deal with impacts in the Great Lakes Corridor. As part of the NY/NJ/PHL Redesign and the Potomac Consolidated TRACON Redesign, airspace changes to accommodate holding within terminal airspace are being explored. Terminal holding should facilitate more efficient management of holding patterns, by minimizing coordination between en route facilities (sometimes multiple centers) and the TRACON. (Please refer to the terminal airspace redesign efforts discussed in AD-3.3.)

Changes to the overall airspace structure, including addition of new sectors in the Northeast, Mid-Atlantic, and Great Lakes Corridor, have been proposed as a means for managing workload distribution. Initially, redesign efforts will focus on optimization of existing resources by splitting and restratifying sectors, potentially creating additional sectors. Later efforts will include larger scale redesign actions, including sectorization concepts that may increase sector size and result in consolidation in the number of sectors. Activities included in the National Airspace Redesign System Choke Points Program, Regional Airspace Projects, and High Altitude Concepts represent the airspace changes expected between 2001 and 2006.

With the ever-increasing dynamic nature of en route flows, airspace boundary flexibility is needed to support dynamic airspace management. Concepts surrounding dynamic sectorization include a range of options from limited to full elasticity of what are currently static sector boundaries. Research is on going to determine how much flexibility is warranted and feasible. In the near- and mid-term, this flexibility can be achieved through Limited Dynamic Sectorization (LDR). LDR can be accommodated within most of the current constraints of the NAS infrastructure (automation, communications, etc.). Center by center development of limited dynamic sector configurations (consisting of multiple plans for a single facility, i.e., an LDR "casebook"), allows the team to focus the resources where the congestion exists by selecting one of several plans. This dynamic allocation reduces the need for dedicated resources, and provides more options to manage congestion.

**Benefit, Performance and Metrics**

Decoupling Holding Areas:

- Ground delay programs for congestion due to holding for a TRACON or Airport Demand imbalance should be reduced in number.
- Ground stop programs for congestion due to holding for a TRACON or Airport Demand imbalance should be reduced in number.
- Performance improvements will be based on the variance of scheduled throughput against actual for flows to cities whose arrivals have been identified as receiving unpredictable en route delays due to holding for a specific airport or TRACON.
- Performance improvement is measured by decreases in estimated time en route for flights to cities with arrivals that have been identified as receiving predictable en route delays due to holding for a specific airport or TRACON.

Sectorization, restratification, and reroutes:

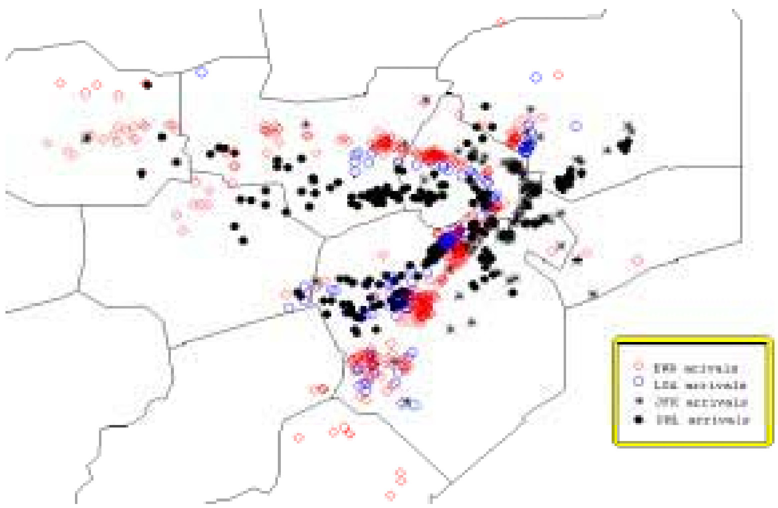
- Ground delay programs for volume congestion should be reduced in number.
- Ground stop programs due to volume congestion should be reduced in number.
- Performance improvements based on the variance in scheduled throughput against actual for flows to cities whose arrivals have been identified as receiving unpredictable en route delays due to volume congestion a sector or set of sectors.

- Performance improvement is measured by decreases in estimated time en route for flights to cities with arrivals that have been identified as receiving predictable en route delays due to volume congestion a sector or set of sectors.
- Restrictions used to manage sector complexity and congestion should be reduced

Limited Dynamic Sectorization:

- By dynamically balancing traffic flows, complexity should be more manageable resulting in increases in sector throughput rates.
- Restrictions used to manage sector complexity and congestion should be reduced by using LDR.

## ER-1.1 Move Holding for Washington, NY Airports and PHL



**Airborne Holding Locations for EWR, LGA, JFK, PHL**
**(VFR days, April 1999)**

**Scope and Applicability**

- En route holding within the Great Lakes Corridor for New York and Philadelphia metropolitan airports has been identified as one of the National Airspace Redesign System Choke Points. Smoothing, Choke Point Action Item #16, is in process of operational evaluation. The concept of smoothing is three-fold: a change to NRP egress points, rerouting of aircraft through Canadian airspace, and application of traffic management procedures to alleviate complexity in en route airspace.
- In the mid-term, the Potomac Redesign project is examining airspace design alternatives that bring holding patterns for DC metropolitan airports into the Potomac Consolidated TRACON. The planned implementation for the PCT Redesign is 2003.
- In the long-term, the NY/NJ/PHL Redesign project is examining airspace design alternatives that bring holding patterns for the major New York airports under the control

of NY TRACON (N90). The planned implementation for the NY/NJ/PHL Redesign is 2005/2006. Current alternatives are considering the use of terminal holding patterns.

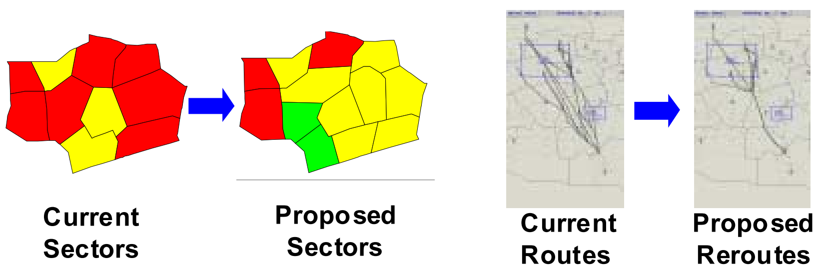
**Key Decisions**

- None identified.

**Key Risks**

- Environmental impact assessment may be required. The implementation timeframe for these projects could increase significantly depending on the level of environmental assessment required by the proposed change.
- Air Traffic needs to determine additional staffing requirements associated with moving holding traffic into terminal areas.

## ER-1.2 En Route Airspace Optimization and Redesign




**Scope and Applicability**

The optimization and redesign of en route airspace consists of two main concepts. The first involves changing the number or size or shape of the sectors in the en route airspace. The second involves adjusting existing routes or developing new routes through these sectors. These techniques can be applied separately or together to alleviate congestion and complexity in the en route airspace.

- In the near-term, approximately 40 new sectors have been identified as part of the National Airspace Redesign System Choke Points Action Plan. These sectors are located in the en route and terminal facilities in New England, Eastern, and Great Lakes Regions. Currently, five of these new sectors, located in ZID, ZOB, and ZAU, have been approved and are scheduled for implementation in 2001. The other sectors await prioritization decisions and funding allocation.
- In the mid- and long-term, en route restratification and resectorization is planned for all en route centers in the U.S. Redesign plans have scheduled completion of these airspace optimization projects between 2002 and 2006, including Kansas City ARTCC in 2002, Oakland ARTCC and Los Angeles ARTCC in 2004, and Great Lakes Corridor centers in 2006.

- Rerouting is being used to primarily east of the Mississippi to address complexity and congestion. In the near- and mid-term, reroutes are being used to address several of the System Choke Points in the Great Lakes Corridor and traffic flowing north-south between the Great Lakes and Northeast to Atlanta and Florida.

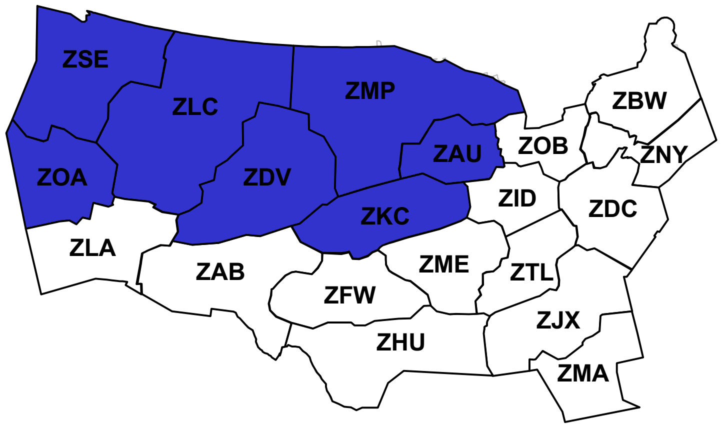
**Key Decisions**

- There are currently over 700 sectors in the NAS, with over 100 additional sectors under consideration. In the near- and mid-term adding or splitting sectors may be the only way to alleviate key areas of congestion in the en route airspace. Air Traffic needs to determine the right level of sectorization, if/when it will need to pursue a strategy to reduce the number of sectors (while addressing the concerns of increased complexity and congestion) and evaluate how evolving technologies can support the reduction of the number of sectors.

**Key Risks**

- Several infrastructure adjustments will be needed to support new sectors, including ATC automation, controller position equipment, and additional frequencies. Lack of availability of these systems may negatively impact the ability to transition to new sectorization or to implement additional sectors.
- VTABS (VSCS Training and Backup System) capacity is limited to 50 positions in each en route center. Upgrades and expansion are not available. There are no program requirements or funding to provide needed additional capacity. Currently no additional sectors can be added to ZAU (maxed out at 50 positions); ZOB is at 48 positions.
- Air Traffic needs to determine additional staffing requirements associated with new sectors. Inability to provide resources to staff these new sectors may impact the ability to transition to new sectorization or to implement additional sectors. An agreement with NATCA has been reached on staffing for the first five choke points sectors, but additional negotiations will be required for new sectors.

## ER-1.3 Implement High Altitude Redesign




High Altitude Redesign – Phase 1

**Scope and Applicability**

The objective of the High Altitude Concept is to provide aviation users the greatest opportunity to operate on their preferred profiles and at efficient altitudes. When the High Altitude Airspace Concept is fully implemented, the FAA will utilize technology and airspace concepts/designs to provide the most efficient flight to aircraft operating in high altitude. The airspace will be designed to allow this flexibility with minimal constraints due to boundary conditions and maximum latitude for required maneuvers.

The High Altitude Concept uses an evolutionary implementation approach timed to match airspace design, adaptation, automation, and infrastructure development timelines. This approach capitalizes on available technologies to deliver early benefits while concurrently developing the longer-term requirements. These items include sector characteristics, alignment of the airspace with existing and/or new organizational structures, and cognitive and display requirements for modification to decision support tools.

In the mid-term, Phase 1 of the High Altitude Concept will implement as many operational changes for flexibility as possible within the constraints of the current automation and infrastructure. The airspace will be designed to provide the maximum utilization of point-to-point navigation given these constraints. To achieve desired flexibility the airspace will be designed for RVSM operations. RNAV routing for the high altitude will be designed to most efficiently accommodate the transition to high-density terminals and to support the avoidance of active special use airspace.

In the long-term, later phases of the High Altitude Concept will incorporate procedural separation on closely space routes, full domestic RVSM (see ER4), and required time of arrival for transition into en route and terminal airspace.

Phase 1 begins with a seven-center demonstration planned for early 2003. This area provides all the characteristics required to evaluate initial changes in procedures and airspace designs. This airspace includes major city pair flows that include high altitude cruise as well as transitioning aircraft from ocean tracks. During the demonstration, a decision will be made on the most effective next step. That is, whether to proceed by first extending the procedures and designs to lower altitudes within the seven centers or extending procedures and designs across all 20 centers.

In preparation for later phases, validation and requirements activities will be conducted concurrently with Phase 1. This activity includes the analysis and engineering studies needed to develop requirements for automation, infrastructure, procedures, sector design, and organizational alternatives (including staffing requirements, team dynamics, sector team composition) to achieve the full objectives of the High Altitude Concept. The best characteristics for high altitude sectors and related organizational structures will be developed and evaluated against current and forecast traffic characteristics, opportunities afforded by improved airborne and ground based technologies, and potential improvements in decision support tools.

**Key Decisions**

Phase 1 Demonstration:

- The FAA and user community need to determine if the airspace designated for the High Altitude Airspace operations will be exclusionary and mandate equipage levels. If exclusionary airspace is identified, transition paths will need to be developed to accommodate non-equipped users.
- Users will require access to information on SUA scheduling and usage to allow them to define and file optimal trajectories. This includes information on ATCAA usage. SAMS will be the primary mechanism to provide the data. Procedures and mechanisms for public access to the data are being developed.

Later Phases:

- The FAA needs to establish the expansion plans for the High Altitude Concept (when to expand to lower altitudes and beyond the initial seven-centers), including the final altitude floor for the High Altitude Concept.
- Rulemaking for mandated equipage or exclusionary airspace use will be needed.
- Adoption of a uniform grid naming convention and its inclusion into the enroute adaptation will be needed. This grid naming convention provides a rich uniform net of fixes to support user development of RNAV profile, clear minimal change clearances for required controller intervention and a robust procedural backup to automation failures.
- The FAA needs to determine sector characteristics (size, team composition, communication and automation requirements, etc.) to provide the most efficient individual flights and flow in high altitude cruise.

- Changing controller areas of expertise to include those related to vertical structure as well as today's horizontal area structure will be needed.
- The FAA should decide on the appropriate facility structure (number and size of en route facilities) to effectively support the High Altitude Concept, including management of the staffing, training, automation, displays and infrastructure to support the sectorization.

**Key Risks**

Phase 1 Demonstration:

- Charting and real-time management of all forms of airspace usage (i.e., ATCAAs) is needed to support development of user-preferred routing that require minimal controller intervention.
- Funding for operational positions (overtime in the short-term) and ability to hire controllers for new positions will impact ability to implement the concept.

Later Phases:

- Several infrastructure adjustments will be needed to support new sectors. Availability of these systems may impact the ability to transition to implement concept:
  - ATC Host/ARTS automation.
  - Frequencies for transitioning and new sectors; enlarging sectors would affect the ground communications infrastructure. Existing radio sites may not provide adequate coverage for the larger sectors, so two or more sites containing radios operating on the same frequency may be required.
  - There may be a need to modify surveillance linkages, and existing ground automation systems may not be capable of accepting additional inputs. Other infrastructure considerations include system adaptation and the possible use of new coordinate systems.
  - CRCT at affected centers. Initially at ZSE, ZLC, ZOA, ZMP, ZDV, ZKC.
  - URET at affected centers. Initially at ZSE, ZLC, ZOA, ZMP, ZDV, ZKC.
  - TMA at affected centers. Initially at ZSE, ZLC, ZOA, ZMP, ZDV, ZKC.
- TMA/URET/ETMS upgrades to provide accurate estimates of arrival times upon which to base RTAs.
- Funding for operational positions (overtime in the short-term) and ability to hire controllers for new positions will impact ability to implement the concept.

# ER-1.4 Multiple Sector Configurations

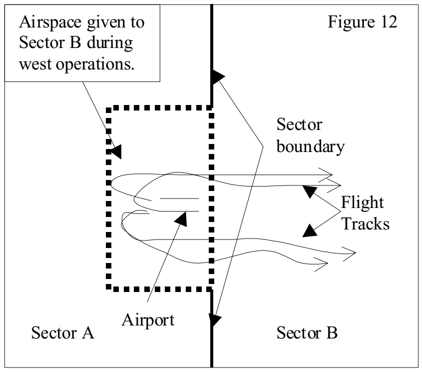



Figure 12

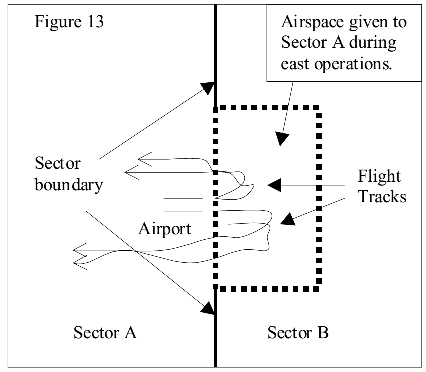



Figure 13

## Scope and Applicability

Airspace boundary flexibility in the near- and mid-term can be achieved by leveraging the limited flexibility that already exists in the system. Many facilities have found ways to support a limited form of dynamic sectorization within the constraints of current automation. These strategies that are feasible without modifying the current automation system are referred to as Limited Dynamic Resectorization (LDR).

Several en route centers apply LDR to address equipment outage (ZMA), weather (ZJX), special use airspace (ZJX), airport configuration change (ZTL), traffic volume (ZMP), and oceanic track change (ZOA). The LDR Casebook has been developed using these centers as examples of LDR application. The casebook has been distributed to all 20 ARTCCs with expectations of proliferating LDR concepts within the near- and mid-term time frames.

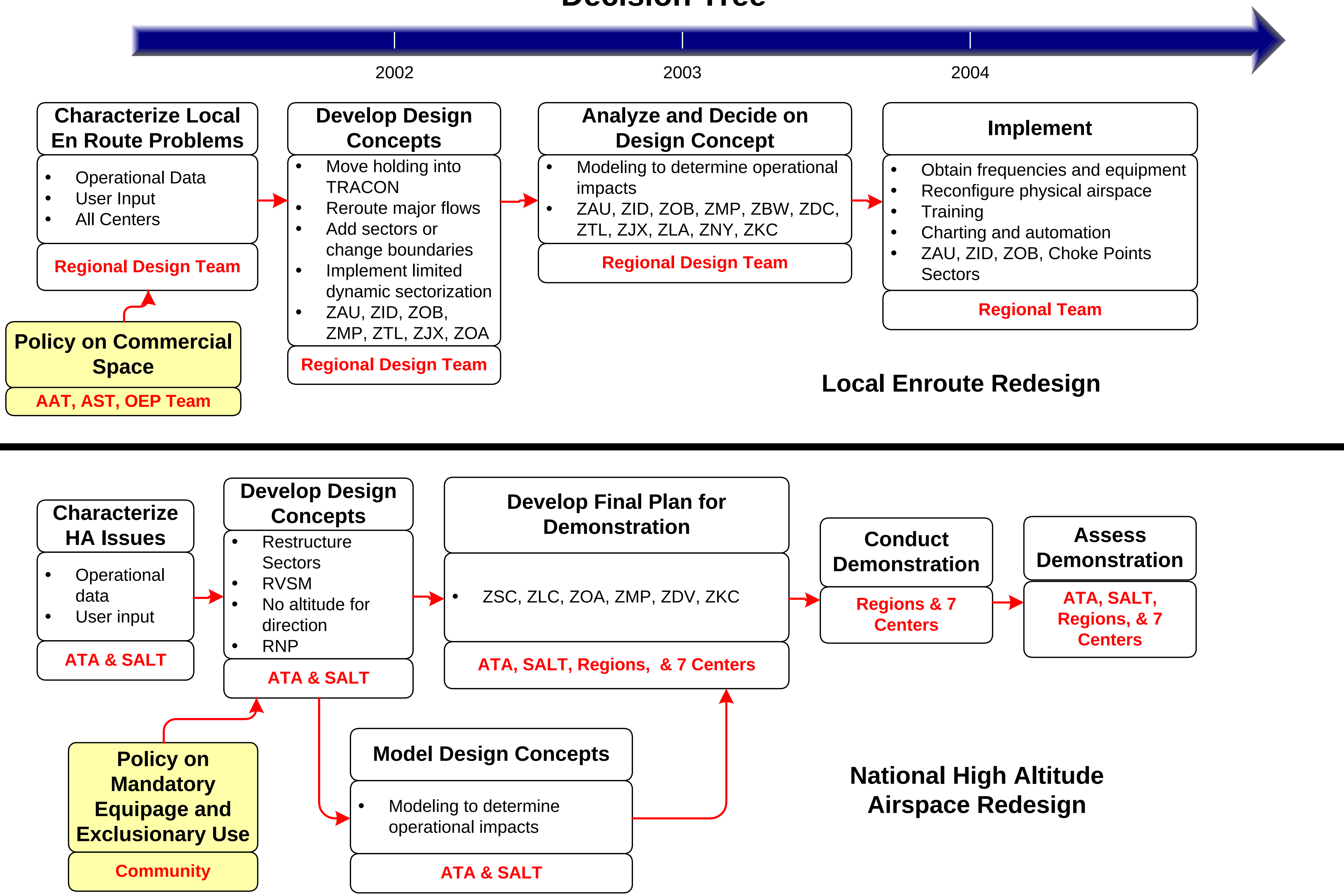
## Key Decisions

- The FAA should determine appropriate operational situations where LDR can be applied (beyond current implementations) and expand usage.
- The FAA should determine requirements for additional dynamic sectorization concepts beyond LDR and evaluate the merit and return on investment of full dynamic sectorization.

## Key Risks

- None identified.

# ER-1: Match Airspace Design to Demands
# Decision Tree



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# Solution: Collaborate to Manage Congestion

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Congestion may appear for brief periods of time at non-routine locations or at different hours of the day. Such congestion may be avoided by sharing predictions with users and allowing them to plan accordingly. Coordination of a game-plan for likely events is done ahead of time to ensure an effective response. Based on results from the collaborative process used for the severe weather season of spring/summer 2000, a program of training has been implemented to prepare controllers, pilots, and airline dispatchers for the spring/summer 2001 activity. Collaborative decision making and information sharing will continue to be emphasized to respond to en route congestion.

**Key Dates**

| | |
|---|---|
| ▶ Operational Rules and Process Changes (Annual Cycle) | 2001 |
| ▶ Train Personnel and Implement Recommendations (Annual Cycle) | 2002 |

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# Responsible Team: Collaborate to Manage Congestion

En Route Congestion Solutions

**Primary Office of Delivery**

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**Support Offices**

ATP-1

AOZ-1

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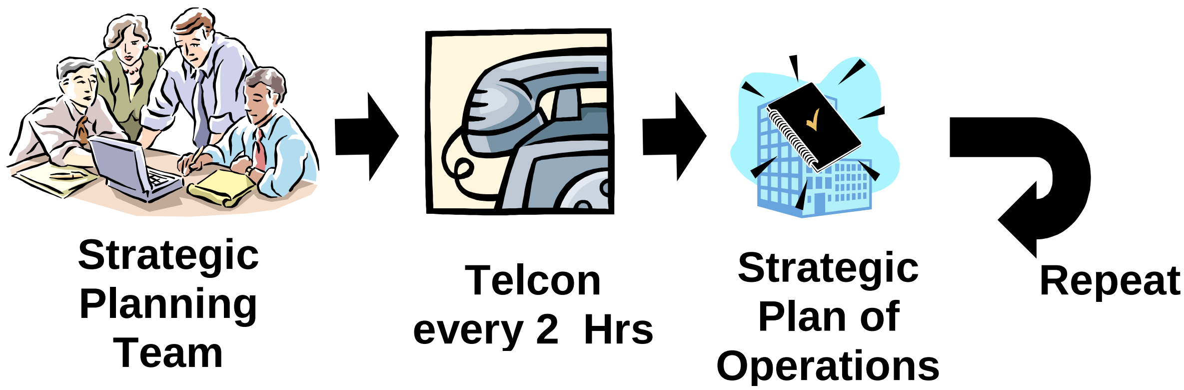
# ER-2: Collaborate to Manage Congestion

## Processes, procedures, and techniques to collaboratively mitigate en route congestion.




**Background**

Certain areas of the National Airspace System, such as the Chicago to northeastern U.S corridor and others east of the Mississippi River, are highly complex and geographically limited. Overall increases in airspace demand, and significant increases during peak demand periods routinely lead to congestion, which can have a ripple effect throughout the NAS, even under the best weather conditions. When areas of high demand are impacted by convective weather the volume and complexity issues are extended dramatically requiring a system wide choreographed effort to minimize service disruption. The Strategic Planning Team (SPT) process, launched by the Spring/Summer 2000 initiative, was designed to foster the effort.

The ATCSCC SPT conducts a telcon among the major FAA facilities and the user community every two hours to discuss the status of the system, constraint projections, and to develop the Strategic Plan of Operations (SPO). The SPO is a collaborative agreement on how to deal with severe weather and other flow constraints and to provide a degree of predictability for all stakeholders by providing a common view of system issues with a look ahead of two to four hours. The spring of 2000 was the inaugural year for the SPT/SPO process. Significant progress was made during the severe weather season of 2000, however, issues remain and improvements can be made. For example, how to improve the strategic plans, balance objectives among the stakeholders, integrate the strategic planning activity with tactical implementation, incorporating feedback, communicating the plan, and improving technology.

**Ops Change Description**

Operational changes will be seen as a continuous improvement to the strategic planning process and system predictability. There will be a greater understanding and collaboration in the identification of the flow constraints utilizing tools such as the Flow Constraint Area (FCA) and Common Constraint Situation Display (CCSD) tools. Enhancements and greater distribution of Flight Schedule Monitor (FSM), providing airport traffic demand and capacity maximization capabilities, when Ground Delay Programs (GDP) are used to support severe weather avoidance plans (SWAP), will continue. Communication improvements utilizing the National Log program and the ATCSCC web site are on going. These and other tools will facilitate strategies applied for a system approach solution by all stakeholders (users and FAA facilities). Operational changes, centered on the SPT process, will incorporate these and other technological improvements in communication collaboration, and predictability. Emphasis will also be targeted towards training on current and future decision support tools. The improvements are evolutionary and thus will span the entire timeframe of near, middle, and long term (2001-2010) and most likely beyond as well. The following sections address the operational changes described:

- ER-2.1: Improved collaboration and communication through shared information.
- ER-2.2: Menu of enhanced pre-planned options.
- ER-2.3: Improved predictability of congestion.
- ER-2.4: Training.

**Benefit, Performance and Metrics**

- Increase on-time arrival rate.
- Increase on-time departure rate.
- Decrease excess taxi times (> 1 hour).
- Reduce the number and/or duration of ground delay programs due to volume congestion.
- Reduce the number and/or duration of ground stops due to volume congestion.
- Decrease the variance in scheduled throughput against actual.
- Decrease estimated time en route.
- Decrease minutes of en route delay.
- Increase flown as filed.
- Increased predictability of the NAS.

## ER-2.1 Improved Collaboration and Communication through Shared Information on FAA/NAS Users Plans and Constraints

**Scope and Applicability**

Near-Term:

- The information provided on the ATCSCC web site (an internet based information dissemination system which provides users quick and accurate NAS information) will be enhanced to provide greater clarity on scope and timing of plans.
- Initial presentation of common information on NAS status and constraints will be provided to the ATCSCC, and facilities, on the Traffic Situation Display, via the Enhanced Traffic Management Systems (ETMS) (a flight data processing and distribution system which utilizes

historical then actual aircraft position and flight intent information), Flow Constraint Area tool (FCA), and to the users via ETMS Common Constraint Situation display (CCSD).

- The FAA's national log program (an intra FAA Air Traffic Services computer based communications and reporting system for controllers and traffic management personnel to record and distribute daily operational information) will provide a more efficient method of capturing and disseminating information on restrictions (e.g., airport runway configuration changes can be entered and effected facilities addressed for notification).
- Users systems such as the Collaborative Decision Making Network (CDMNet) (a collective network routed through the Volpe Center providing two-way real-time operational data exchange such as cancellation information and NAS status) is continuing to be expanded for better data quality and increased user participation to enhance system demand predictability.
- Spring/Summer 2001 (S2K+1) process improvements are under way including:
  - Collaborative S2K+1 field training.
  - 24 hour SPT/severe weather unit staffing.
  - Pre SPT checklist usage.
  - Increased staffing levels at FAA field facilities.
  - Improved Pre/Post communication of the SPO.
  - Develop collaborative "rules of the road" procedures.

Mid-Term:

- Information on user intent (e.g., a four hour prior to departure early filing of intent process) would provide enhanced accuracy of predictions.
- NAS status and constraints descriptions will be enhanced through updated versions of FCA and CCSD tools with additional Collaborative Routing Coordination Tool (CRCT) (a prototype tool which utilizes aircraft trajectory modeling along with flight schedule information to produce solutions to airspace capacity and en route weather constraint problems) functionality's, to provide information on the potential impact of plans on the NAS.

Long-Term:

- Continuous improvement of data provided by the FAA and NAS users for enhanced collaboration.

**Key Decisions**

- Access to data and information that is currently considered to be sensitive or company proprietary is at issue. There are security, company proprietary, and privacy restrictions on some of the information that has been requested for inclusion in the information exchange.
- Data quality standards adopted (e.g., timely cancellation notification that will allow maximum utilization of available airport capacity).
- Data sharing parameters adopted (e.g., inclusion of GA flight intent as early as possible).

- Common metrics identified for operational analysis and problem identification.
- Common goals and targets adopted to achieve a “System Thinking” approach.
- Operating “rules of the road” adapted to foster equitability for user groups.
- Expanded authority of the FAA to enforce compliance when “gaming” of the system is identified.

**Key Risks**

- The numbers of stakeholders (airspace users and FAA facilities) that need to be involved in the collaborative process are very large. The sheer volume and diversity of stakeholders makes communication and technology compatibility, to achieve a common system understanding, very difficult.
- User equitability may not be ensured in the interim, during transitions to full collaborative participation, due to incomplete intent data, the need for an agreed upon reduced en route capacity rationing process.
- Data sharing enhancements.
- Systems connectivity between stakeholders may not be fully established due to the diversity of stakeholder systems or operational environments (e.g., a major air carriers AOC fully connected to decision support tools through the CDMNet versus a single business jet operator whose preflight information comes from an Fixed Base Operator (FBO) or Duats).

## ER-2.2 Improved Collaboration and Communication: Publish a Menu of Enhanced Preplanned Options for Congestion Management

**Scope and Applicability**

- Near-, Mid-, and Long-Term - Coordination of route modifications in a timely manner was a high priority item going into the spring of 2000. The goal of reducing the time needed to express clearance changes over already congested voice frequencies necessitated abbreviating the clearances in a standardized and database adaptable format. The National Playbook, Coded Departure Routes (CDR), and Low Altitude Arrival and Departure Routes (LAADR) routes are means of achieving this goal. The Playbook and CDRs have been used successfully during congestion situations during the year 2000 and LAADR, while only used at St. Louis under a MOU between ZKC and TWA, has shown to be an effective program. Enhancement to these programs, such as, program expansion, and improved distribution is a continual process. Playbook and Coded Departure routes are available on the ATCSCC web site and the CDM web site.
  - Identify cycle and process for updating published “plays”.
  - Post updates on the ATCSCC web site.

**Key Decisions**

- Increase incorporation of pre-planned routes into flight planning systems and Aircraft flight management systems (FMS).

**Key Risks**

- Dynamics of tactical real-time situations often require of revision pre-planned options.
- Improved coordination and communication when activating pre-planned options or changes to pre-planned options may require automation improvements to FAA/User systems.

## ER-2.3 Technology: Improved Predictability of Congestion and Resolution Assessment

**Scope and Applicability**

- The enhancements of existing decision support systems and the addition of new decision support systems (DSS) and/or tools will improve the timeliness, accuracy, and quality of congestion predictions and resolutions. In the near, mid, and long term, continuous improvement programs to increase predictability of congestion and provide quality resolution assessment are:
  - Enhancements to the Collaborative Convective Forecast Product (CCFP) which will provide a more accurate view of long term convective weather constraints.
  - Enhanced Traffic Management System upgrades (i.e., FCA functionality) which will better define airspace capacity reductions and support resolution capabilities.
  - Continued evaluation of the Collaborative Routing and Coordination Tool (CRCT) functionality to be transferred to the FCA tool.
  - Complete full adaptation of the Departure Spacing Program (DSP) to assist in maximum delivery of aircraft from the terminal area.
  - Improved Ground Delay Program (GDP) in support of SWAP for en-route congestion.
  - Revised process for using Flight Schedule Monitor (FSM) when implementing Ground Delay Program (GDP) in support of swap for en-route congestion.

**Key Decisions**

- Decision Support Systems (DSS) integration.
- Establish an Early Filing of Intent program.

**Key Risks**

- Quality of input data for strategic planning time horizons is highly variable. Improve data quality, access and usage will need to be revisited or established.

## ER-2.4 Training: Expansion of Joint FAA/Airline Initial Training, Recurrent Training, and Analysis

**Scope and Applicability**

- Near-, Mid-, and Long-Term - All participants in strategic planning for traffic flow management (users and FAA) need to have common training on traffic flow management (TFM) techniques, procedures and processes. The following programs have begun prior to the Spring 2001 convective weather season and will be on going as part of a continuous improvement process.
  - System operations advocacy training.
  - S2K+1 field training (option B) for FAA and users at various geographic locations.
  - ATCSCC training (option A) for FAA and users at the ATCSCC.
  - National traffic management course #50113 for FAA and users at the ATCSCC.
  - ATCSCC personnel familiarization visits to field facilities.
  - ATT facility manager, TMU team training.
  - Leadership pair training.
  - MTO visitations.
  - Field traffic management visitations.
  - Video development for FAA and user recurrent training programs.
  - Develop revised training package for initial training.
  - Develop and disseminate revised training materials based on lessons learned for recurring training.
  - Post analysis to evaluate events, process, and procedures.
- In addition, post event analysis for feedback and recurrent training is needed to provide information on lessons learned, employing improved techniques and processes.

**Key Decisions**

- Providing resources and ensuring maximum participation for joint FAA/User training.
- Access to data, data standards, data sharing, and common metrics for analysis and feedback.

**Key Risks**

- Data quality.

# ER-2: Collaborate to Manage Congestion Decision Tree

V3.0 (30 May 2001)

Oct 01 | 11 | 12 | 1 | 2 | Mar 02

## Annual Operational Review

- Collaboration: Strategic Planning Process, Data Sharing
- Communication: Strategic Planning Process, Pre-planned Options (Playbook)
- Technology: Systems/Tools, Infrastructure, Decision Support Systems Integration, Automation

**FAA**

## Training

- Procedures
- Tool Use

**Community**

## Implementation of Recommendations

- Strategic Planning Process
- National Log Program
- Operational Rules
- Data: Concensus on Quality, Standards, Sharing, Metrics
- FCA Tool
- CCSD Tool

**Community**

## Compliance Assurance

**FAA**

## Continuous Process Improvement:

**Review, Implementation of Recommendations, and Training are ongoing activities following an annual cycle.**

# Solution: Reduce Voice Communication



A significant portion of the controller workload is voice communications with the pilots. Application of selective communications services over controller-pilot data link communications reduces the use of en route voice communications. This change frees controller time and makes better use of the voice frequencies resulting in higher sector productivity, and an ability to accommodate the projected growth.

**Key Dates**

| | |
|---|---|
| PETAL 2 Trials | 2001 |
| CPDLC Build I at MIA | 2002 |
| CPDLC Build IA | 2003 |

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ATP-1

AUA-200

AIR-100

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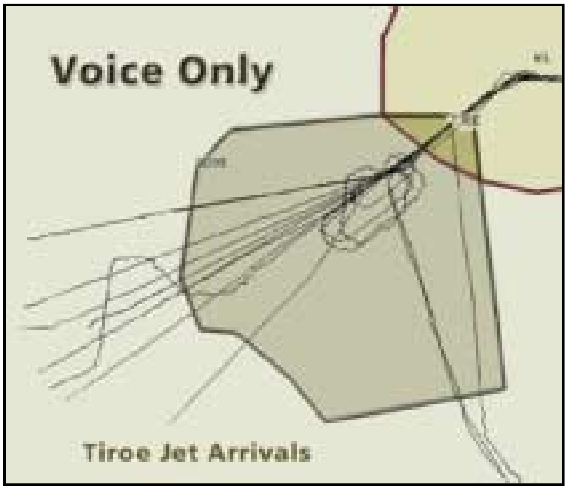
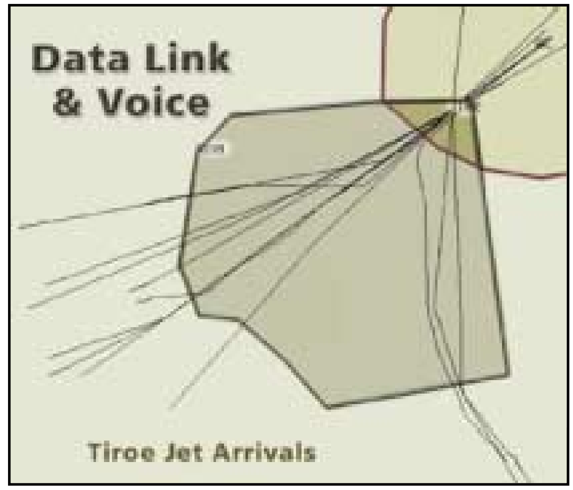
# ER-3: Reduce Voice Communication

## Reduce flow constraints by reducing voice communications workload.




**Background**

Pilots and radar controllers work together through voice communications to manage the flow of air traffic through the NAS in a safe and efficient manner. Structured sets of phrases have been developed for exchanging information and clearances, and for making requests. Standard phraseology is used to mitigate some of the limitations of oral communications. A number of the exchanges between pilots and controllers involve the exchange of routine information that is repeated for most aircraft entering or exiting a sector.

From a safety perspective, the primary sources of communication problems between controllers and pilots include: acoustic confusion; transposition of alphanumerics; “read-back” and “hear-back” errors; overlapping or simultaneous transmissions; misinterpretation caused by poor pronunciation; failure to use standard phraseology; manual data entry errors; and improper or malfunctioning radio keying operation. These communication failures contribute to a significant percentage of operational errors as well as reducing overall NAS efficiency.

As demand for access to the NAS increases, sectors shrink and the number of potential trajectory conflicts increase causing the controller-pilot communications burden to increase at a faster rate. In addition, the clearances needed for flexible routing, congestion management, and weather avoidance necessitate the exchange of complex route information between controllers and pilots not easily supported by oral communication. The provision of air traffic services via the use of data communications is a key means of addressing the safety, efficiency, and capacity constraints of the current voice communications-based NAS.

## Ops Change Description

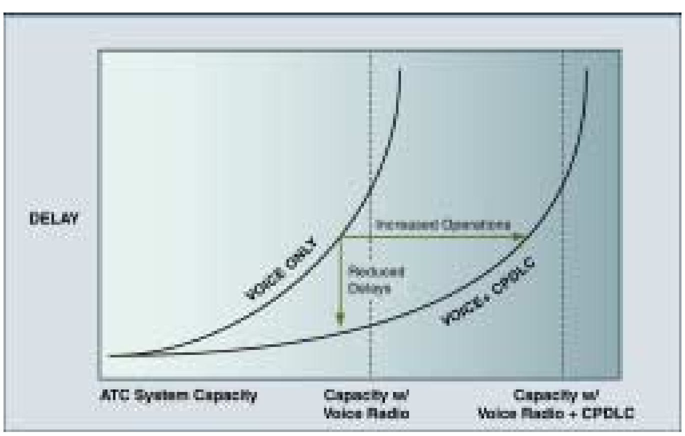
One of the key operational changes to reduce voice communication workload underway in the domestic en route environment is the use of the Aeronautical Data Link System (ADLS). ADLS has as its leading application Controller-Pilot Data Link Communications (CPDLC). The use of CPDLC is initially intended to replace routine communications (Build I), to transmit speed, heading, and altitude clearances to pilots through data communications and to allow pilots to request altitude changes (Build IA). These capabilities will allow controllers to better distribute communications responsibilities among all members of the sector team. This change permits optimal use of the voice communications channel and increases sector productivity. The implementation of CPDLC Builds I and IA also involves the introduction of an Aeronautical Telecommunication Network (ATN) intended to become the standard global mechanism for data communications.

Augmenting CPDLC Builds I and IA, the next incremental changes introduced through ADLS will be the ability of controllers to send conflict-free routes developed on the User Request Evaluation Tool (URET) via CPDLC without re-entry.

## Benefit, Performance and Metrics

Reduced voice communications workload and distributed communications responsibility combine to provide the following benefits. Note that benefits increase as user equipage increases:

- Enhanced safety reflected by decreased operational errors and increased communications accuracy.
- Increased flight efficiency reflected by less time and fewer miles flown in sector (demonstrated decrease in controller experiment using Atlanta's TIROE arrival sector with a 90% equipage level).
- Increased airspace capacity reflected by increased sector traffic throughput (miles in trail restrictions relaxed in an experimental sector based on voice communication reduction) and reduced delay (see chart below).




FAA, *User Benefits of Two-Way Data Link Air Traffic Control Communications Aircraft Delay and Flight Efficiency in Congested En Route Airspace.*

FAA, *Benefits of Controller-Pilot Data Link ATC Communications in Terminal Airspace.*

## Scope and Applicability

- CPDLC is intended for use in en route airspace and requires a commercially provided digital air-ground infrastructure. Airspace users require proper equipage to use the service.
- Customer demand and equipage will drive service coverage and benefits.
- Initial data link (CPDLC Build I) will be deployed to Miami Air Route Traffic Control Center (ARTCC) in 2002 with four services: Transfer of Communication, Initial Contact, Altimeter Setting, and Predefined Instructions via Menu Text.
- Enhanced data link (CPDLC Build IA) extends data link capability to all 20 domestic ARTCCs beginning in 2003 and adds the following services: Altitude Assignment, Speed Assignment, Heading Assignment, Route Clearance, and Pilot Initiated Downlink.

## Key Decisions

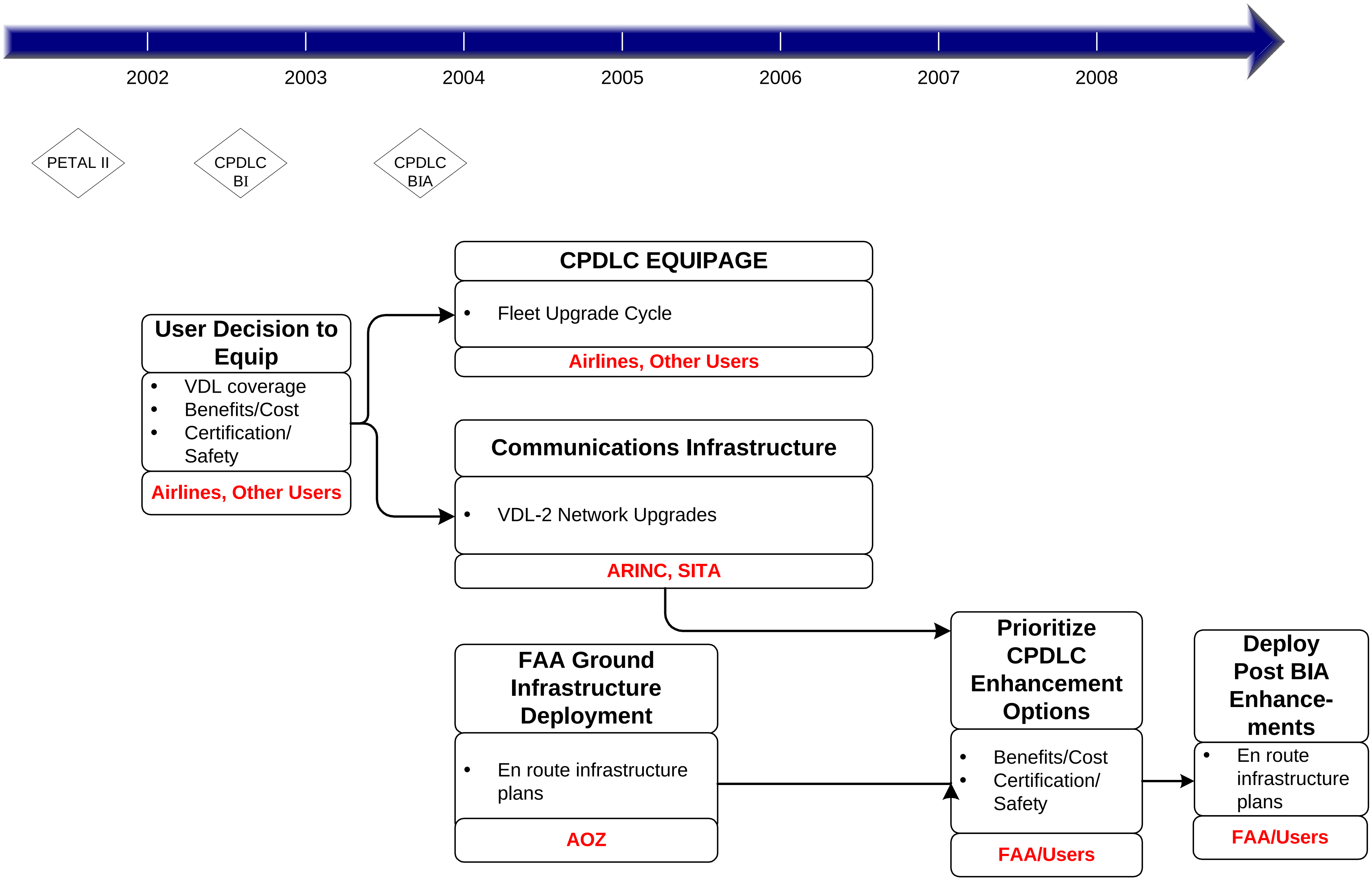
- CPDLC communications will not be effective unless VDL-2 coverage is available across a significant portion of the NAS in order to make equipage cost-effective. If coverage is insufficient, users may not equip and controllers may not be able to utilize the capability.
- Airspace users need to make their requirements known to their commercial communications service providers.
- Members of the user community must make decisions to equip aircraft with the needed avionics. The rate of equipage is critical, because benefits from CPDLC are accrued when there is a significant percentage of equipped users in the airspace.

## Key Risks

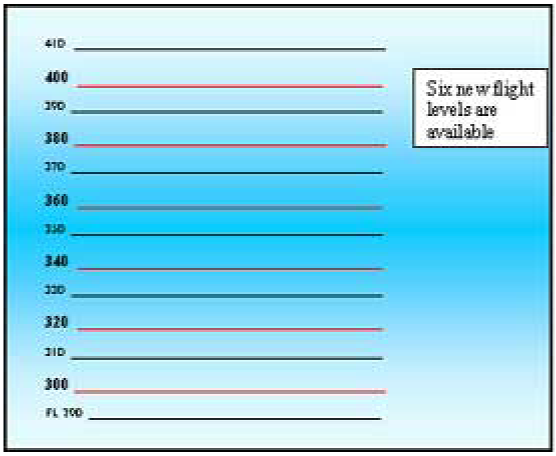
- System elements developed independently by stakeholders (e.g., FAA, ATN software vendors, avionics manufacturers, commercial communications service providers, and other air traffic service providers) must be interoperable.
- VDL-2 coverage of the NAS drives benefits. VDL-2 has not been deployed, and adequate coverage has not been validated to ensure contiguous communications.
- Experience is limited in the certification of cooperative air-ground systems. There is a need to acknowledge and credit the use of legacy and COTS systems and software in the end-to-end certification process.
- CPDLC represents a significant change in the human factors in the cockpit and the sector team and their interaction. This will require attention to ensure successful implementation.

V3.0 (30 May 2001)

# ER-3: Reduce Voice Communication Decision Tree



# Solution: Reduce Vertical Separation




Reducing vertical separation between aircraft can increase the physical capacity of airspace. Demand is highest for cruise altitudes between 26,000 and 41,000 feet (flight levels FL 260 and FL 410). Flights above FL 290 maintain 2000 feet vertical separation, limiting the available cruise range flight levels. The first step for reducing vertical separation will begin with FL 350-390 and progress toward coverage of the full envelope. Flights in this range will have additional options for cruise altitude, providing additional flexibility for the controller and increasing capacity for users in high traffic areas. General aviation aircraft will be allowed to transition through the airspace to reach their desired altitudes.



**Key Dates**

| | |
|---|---|
| Accommodation of Non-Approved Aircraft | 2001 |
| Plan for Phased Implementation | 2001 |
| Rulemaking Final | 2003 |
| First Phase of Operational Use | 2004 |



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**This page was last updated on May 30, 2001**

# Responsible Team: Reduce Vertical Separation



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NAS & International Airspace Analysis Branch: ACT-520

Automation: AUA-200

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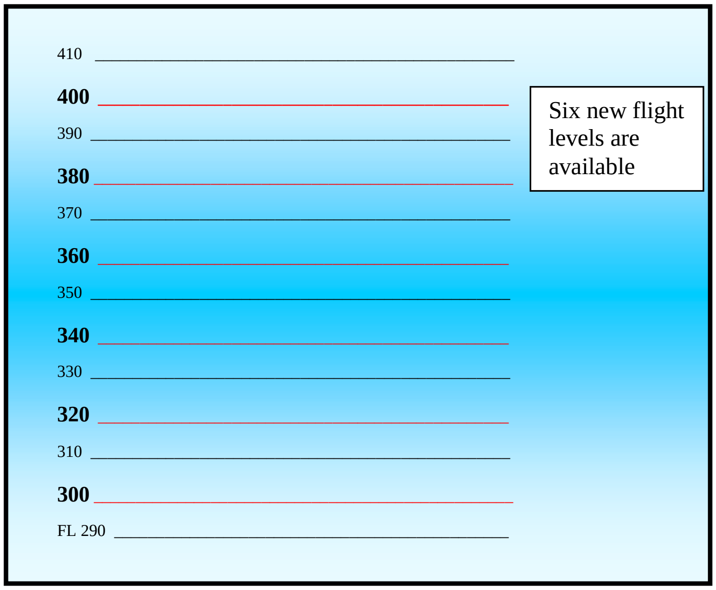
# ER-4: Reduce Vertical Separation

## Reduce vertical separation minima to 1,000 feet for flights operating between 29,000 feet and 41,000 feet.




### Background

In US domestic airspace 1,000 foot vertical separation is applied up to FL 290 and 2,000 foot vertical separation is applied above FL 290. The Reduced Vertical Separation Minimum (RVSM) allows 1,000 foot vertical separation to be applied between FL 290 – 410 (inclusive). RVSM was implemented in the North Atlantic initially between FL 330-370 in March 1997 and expanded to FL 310-390 in October 1998. It was implemented in pacific oceanic airspace between FL 290-390 (inclusive) in February 2000.

Aircraft that are approved for RVSM are eligible to conduct RVSM operations worldwide. The operator, however, must also adopt ATS operational policies/procedures specific to individual areas of operation. Approximately 22% of aircraft that operate in the US above flight level 290 are RVSM approved as of March 2001 (2,400 of 11,100).

### Ops Change Description

Implement RVSM in phases in the vertical stratum of US domestic airspace (e.g., initially implement between FL 350-390 (inclusive) with progression toward RVSM implementation in the full RVSM envelope (FL 290-410 (inclusive)). Phased implementation allows aircraft that are not RVSM approved at the start of Phase 1 to operate with limited operational penalty until phased out of service or modified to RVSM standards. Phased implementation provides flexibility for operators of aircraft that will be costly to modify. It also provides operators flexibility to plan RVSM modifications during scheduled maintenance inspections avoiding greater costs associated with special inspections. Non-equipped aircraft will be allowed to transition RVSM strata to operate normally at higher altitudes.

## Benefits, Performance and Metrics

- Fuel Burn Savings. Fuel burn savings of approximately 1% per cent for US domestic operations. (***Preliminary*** analysis estimates that ***upper bound*** for fuel savings, when RVSM is implemented between FL 290-410, will be approximately $400 million per year).
- Increased Flight Level Availability. Makes six additional flight levels (for a total of 13) available for operations between FL 290-410. (Current FL orientation schemes applied between FL 290-410 provide seven useable FL's).
- Airspace Capacity. Increases airspace capacity. (Other factors, however, may limit the number of aircraft that can be managed).
- Controller Flexibility. Enhances controller flexibility. Provides more options for situations such as weather re-routes and crossing traffic.
- Controller Workload. Reduces controller work load.
- Enhanced Predictability. Enhances predictability of operations by increasing the flight levels available to move aircraft allowing more aircraft to fly at requested flight level.
- Delays. Decreases potential for delays caused by limitations in en route airspace capacity above FL 290.

## Scope and Applicability

The Domestic Reduced Vertical Separation Minimum (DRVSM) Team has held meetings with user advocate groups and DoD. Such meetings will be scheduled periodically to inform and obtain feedback from users. Also, RVSM seminars will be held to educate users and FAA field offices on RVSM program requirements.

- July 16, 2001: proposed Phase 1 implementation date and - plan - to be finalized and coordinated with industry.
- December 2004: proposed Phase 1 implementation between FL 350-390 (inclusive).
- TBD: implement Phase 2.
- TBD: implement the full RVSM envelope (FL 290-410 (inclusive)).

## Key Decisions

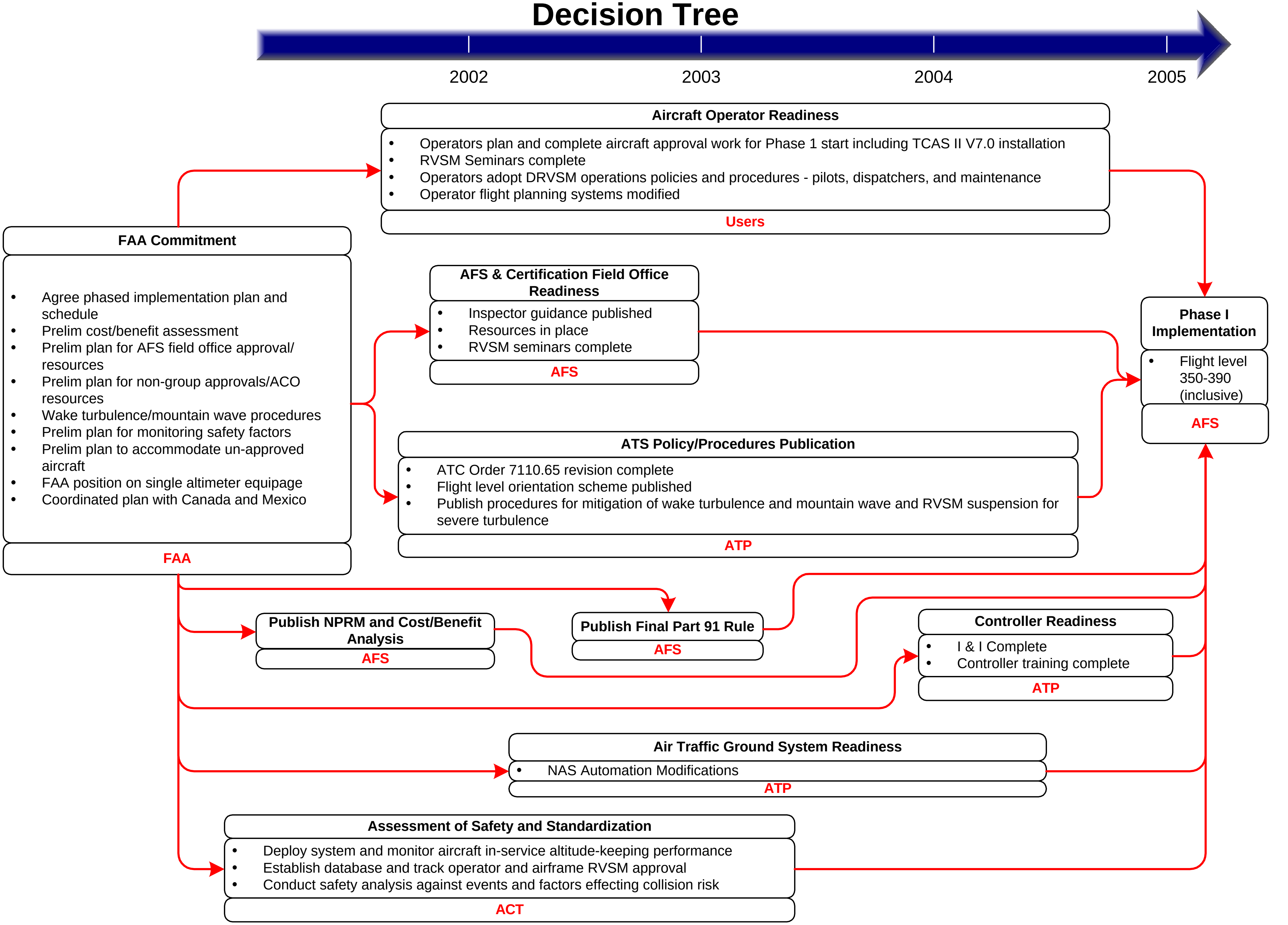
- Phased implementation dates and vertical stratum.
- Necessity to implement RVSM considering benefits and costs.
- Policy for accommodation of non-RVSM approved aircraft including military aircraft.
- Eligibility of small aircraft equipped with a single altimeter system.

**Key Risks**

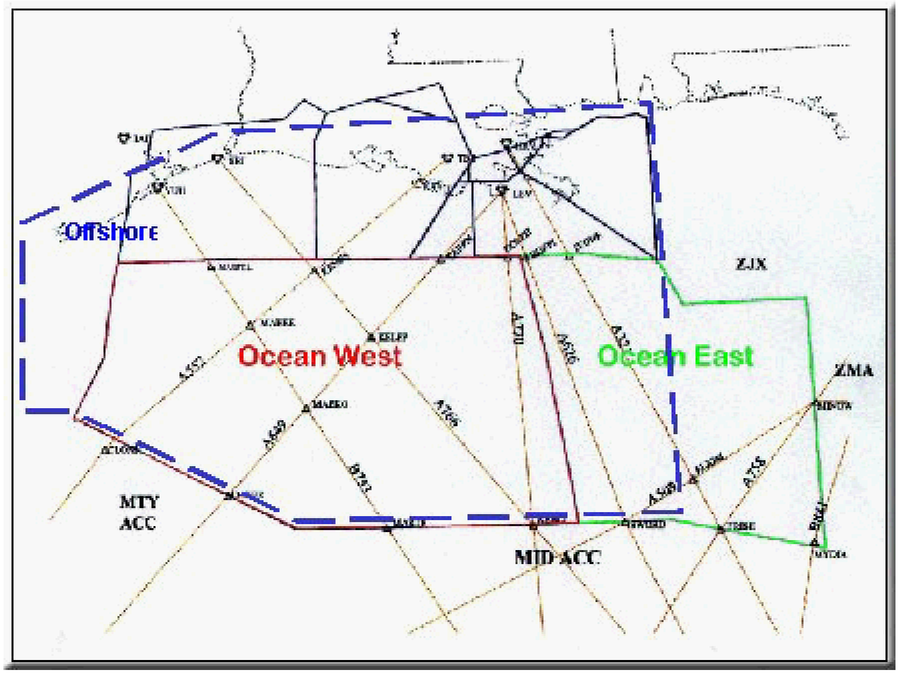
- Cost/Benefit and Phase-In Plan. Acceptance of a cost effective phase-in plan to minimize the impact on aircraft that are expensive to modify (ATP, AFS).
- Accommodation of Un-Approved Aircraft. Acceptance of policies for accommodation of non-RVSM approved aircraft including DoD aircraft (ATP, AFS).
- Wake Turbulence/Mountain Wave. Development of procedures to mitigate the effect of wake turbulence and mountain wave effect (ATP, AFS).
- Flight Standards Field Resources. Development of plans for Flight Standards field office approval of large numbers of aircraft (approximately 8,700) and operators (approximately 900) (AFS).
- Aircraft Certification Office Resources. Development of plans for Aircraft Certification Office resources to approve individual unique (non-group) airframes for RVSM (AIR, AFS).
- Single Altimeter Equipage. Single altimeter system equipage for small aircraft (AFS, AIR).
- Coordination with Canada/Mexico. Coordination of implementation plan with Canada and Mexico (ATP, AFS, ACT).
- Safety Analysis. Acceptability of safety analysis to support the DRVSM implementation decision (ATP, AFS, ACT).
- Operator Fleet Readiness. Operator lead time to schedule/complete aircraft approval work is scheduling pacing factor. Operators must complete required actions in period leading up to implementation (AFS, AIR).
- TCAS Version 7.0. TCAS II, version 7.0 (or later version or equivalent) equipage requirement for aircraft equipped with TCAS II and used in RVSM operations.
- NAS System Modification Host and other system changes. (ATP).
- Pre and Post Implementation Monitoring. Pre- and post implementation monitoring program to assess key factors related to operational safety: data base of approved operators/aircraft; system to monitor aircraft altitude-keeping performance (AFS, ACT).
- Airspace Re-Design. DRVSM impact on High Altitude Airspace Re-design Program (ATP, ATA).

V3.0 (30 May 2001)

# ER-4: Reduce Vertical Separation Decision Tree



# Solution: Reduce Offshore Separation




Air traffic between the United States and destinations in the Caribbean, Mexico, and Central America has grown at a rate of over 8% per year over the last 12 years. Currently, flights that transit the Central Gulf of Mexico are subjected to oceanic separation standards in part because of a lack of direct pilot-controller communications, standardized aircraft navigation requirements and limitations to radar surveillance.

**Key Dates**

| | |
|---|---|
| Introduce RNAV routes to replace J58/86 | 2001 |
| Complete investment analysis to support selection of surveillance system option | 2001 |
| Deploy third VHF communications buoy to provide VHF controller-pilot communications down to flight level 180 | 2001 |
| Domestic Separation Above FL290 in Gulf of Mexico | 2006 |
| Domestic Separation Below FL290 in Gulf of Mexico | 2008 |

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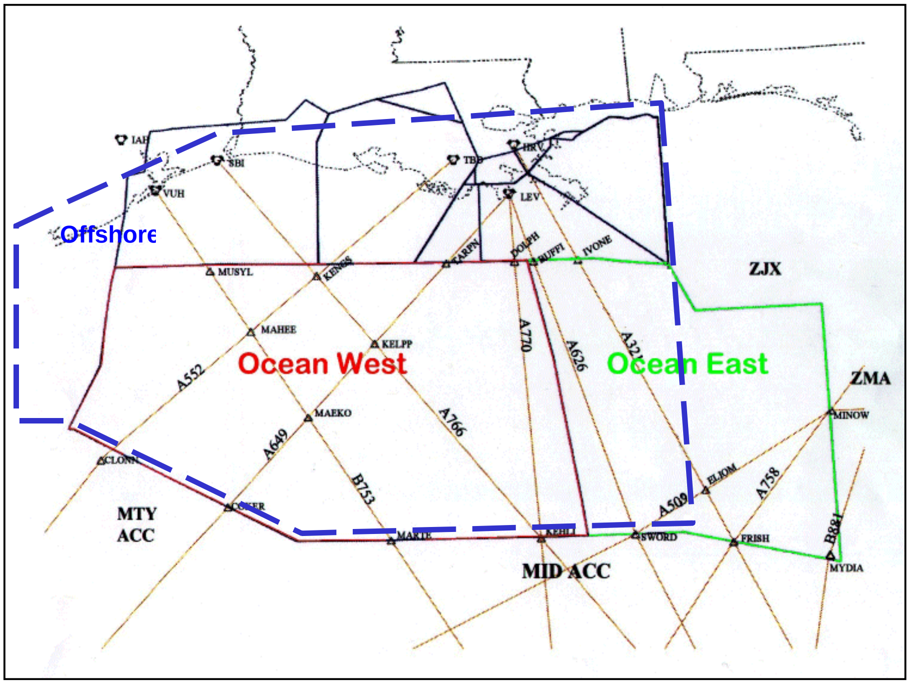
# ER-5: Reduce Offshore Separation

## Provide communication, navigation, and surveillance services similar to domestic en route airspace.




### Background

The National Airspace System (NAS) contains a significant amount of airspace that lacks surveillance coverage. Most notable is the portion contained in the Gulf of Mexico airspace, which is part of the ICAO Caribbean/South American region. An area of approximately 60,000 square miles (roughly the size of the State of Tennessee) in the Central Gulf of Mexico currently lacks all but the most basic Communications/Navigation/Surveillance (CNS) components. Separation assurance in these areas is provided through the use of non-radar procedures, which employ cumbersome and inefficient separation standards.

In the Gulf of Mexico, there are two major user communities: the high altitude users and the offshore users. The background of each user group and their operational environment is described below.

<u>High Altitude</u>:

Demand for the limited number of available slots along the oceanic routes that cross the Gulf has been growing at double digit rates. The surveillance and communication gap over the central Gulf is approximately 400 miles (east-west) by 150 miles (north-south). The use of *procedural oceanic separation* standards is required for any aircraft that flies through this airspace. Recent procedural enhancements have increased the capacity from approximately 45 operationss/hr to 60 operationss/hr, but this additional capacity has already been absorbed by demand. Peak demand currently exceeds capacity for 1.5 hours per day; demand will exceed capacity for 6 hours perday by 2002. By 2005, demand will exceed capacity for 11 hours per day. The anticipated sharp increase in the number of flights between North America and Cuba will exacerbate the situation.

Offshore:

Helicopter flights in support of oil exploration/production are the main offshore users. The revenue associated with Gulf oil production and fishing industries account for approximately 3% of the United States Gross Domestic Product. There are 899 named oil fields with over 5000 landing sites on the oil exploration areas off the coast of Louisiana and Texas, accessed mainly by a fleet of some 610 helicopters. 50% of the world's offshore helicopter traffic occurs every day in the Gulf. There is an average of about 5000 flights per day, with peak traffic of about 9000 flights per day on shift change days. Most of these flights operate VFR. However, on the approximately 100 days per year that inclement weather affects the Gulf, severe restrictions must be applied by ATC. Due to a lack of low altitude communications and navigation infrastructure, current IFR capacity is only 120 operations per day. Demand for air traffic services is expected to grow, as oil exploration and production push further out into the Gulf, and the number of deep water platforms grow. The planned introduction of long range tilt-rotor aircraft into the Gulf will only add complexity to the operating environment.

**Ops Change Description**

Gulf of Mexico operations will be changed to allow the use of domestic en route standards and procedures. These standards and procedures will be supported by the provision of surveillance and direct controller-pilot voice communication coverage across all required Gulf airspace. Appropriate CNS enhancements should be provided for the high altitude users (FL290 and above across whole Gulf) and for the offshore users (above 1500 feet in the oil exploration and production areas). Improved weather products should be made available to the ZHU controllers, airline operations centers, pilots, and other users.

This change will require surveillance and communications capabilities to provide sufficient coverage of the Gulf to support en route-type operations; sufficient automation capability to support the surveillance improvements; wholesale redesign of the airspace into en route sectors, and displays, staffing and training to support those sectors; development and implementation of en route procedures to support all of the above. These changes must be coordinated with ICAO, and the surrounding centers (ZJX, ZMA, Mexico's MID and MTY), so traffic flows within these new Gulf sectors can be handled smoothly. The users must be notified of the changes, any necessary training completed, and any equipage requirements coordinated.

**Benefits, Performance and Metrics**

- Capacity of the high altitude airspace will increase significantly: oceanic procedural (30/hr) to domestic en route (80-100/hr).
- En route delays will decrease.
- Use of customer preferred flight trajectories are expected to increase.
- Ground hold delays will decrease.

- On-time departure rates will increase.
- Offshore planning is expected to be enhanced; elimination or reduction of "one-in one-out" flow restriction at non-radar terminals.
- En route flight stage lengths will decrease, as more aircraft fly their requested altitudes.
- Safety will be enhanced.

**Scope and Applicability**

Gulf of Mexico Working Group (GOMWG). The FAA is progressing on a number of initiatives proposed by the GOMWG to enhance air traffic management in the area. (The GOMWG is a joint FAA/Industry working group that includes representatives from all major GOMEX user groups, as well as representatives from the civil aviation authority of Mexico).

<u>Major Initiatives:</u>

- <u>RNAV Routes.</u> In September 2001, two parallel RNAV routes will be introduced to replace Jet Routes 58 and 86. (J58/86 are based on ground navigation aids). Track spacing will be 18 nautical miles. These routes will require that aircraft be equipped with approved RNAV systems and operate within the system limitations. Direct VHF pilot-controller communications are available and the routes are normally under radar surveillance.
- <u>RNAV Route Expansion.</u> The FAA has established a program to analyze key safety parameters to determine how the application of 18nm track spacing can be expanded to areas of the Gulf that are not under radar surveillance.
- <u>Enhanced Surveillance.</u> The FAA is working with industry to determine if a combination of radar and ADS-B surveillance can be introduced in the Gulf. The introduction of surveillance into non-radar airspace will enable further reductions in aircraft separation. The Investment Analysis to prioritize the options for surveillance systems will be completed in October 2001.
- <u>Communication.</u> The FAA has sponsored the placement of remote VHF transmitter/receivers on three buoys in the Gulf. One prototype buoy is currently deployed in the central Gulf, supplementing VHF controller-pilot communication down to FL280. A second buoy is currently undergoing operational testing. A third buoy will be deployed in fall 2001. Enhanced communication is a key element of air traffic management and safe separation of aircraft. The combination of the buoys and current onshore systems should allow direct pilot/controller communications down to FL180 across most of the FAA's Gulf airspace.
- <u>Reduced Vertical Separation Minimum (RVSM).</u> The GOMWG is coordinating with FAA specialists that are planning RVSM implementation in domestic US airspace with the intent of implementing RVSM in the Gulf on or near the same timeframe.

These initiatives to enhance communication, navigation, and surveillance capabilities will allow for reduced separation standards, while providing parallel benefits to air traffic flow management and increasing airspace capacity and operating performance. The specific decisions on enhanced CNS and other automation are interdependent, and must be treated and assessed as a whole with full awareness of operational and investment tradeoffs for alternatives.

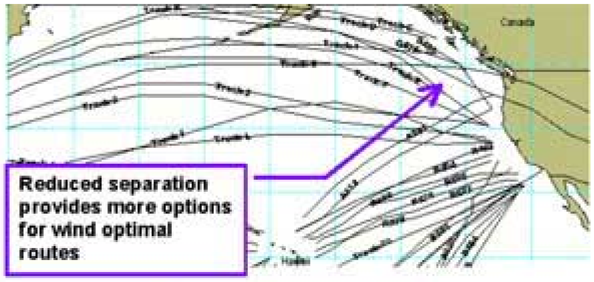
**Key Decisions**

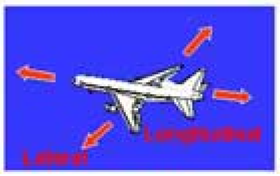
- Consensus must be reached that the benefits of Gulf CNS improvements outweigh related operator costs for equipage.

**Key Risks**

- Trade-off between service provision and equipage alternatives. Different alternatives place different investment requirements on both the FAA and different user groups.
- User equipage.
- Development of plans for approval of large numbers of diverse aircraft types and operators.
- Introduction of exclusionary airspace requires extensive rule making action.

# Solution: Reduce Oceanic Separation




Transoceanic flights are confined to airspace based on separation standards that are defined for manual surveillance and unreliable communications. Allowing properly equipped aircraft to operate at reduced oceanic separation will enable more aircraft to fly optimal routes, enhancing aircraft time efficiency in the oceanic leg of their flight. Reduced separation laterally may provide space for additional routes to current destinations or new direct markets. Reduced longitudinal (nose-to-tail) separation will provide more opportunity to add flights without a delay or speed penalty.

**Key Dates**

| | |
|---|---|
| ICAO Regional Procedures & Guidance | 2003 |
| Determine En-Route Modification | 2004 |
| Initial Operational Use of 30/30 Separation | 2006 |



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Responsible Team

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AFS-400

AIR-100

**Working Forums**

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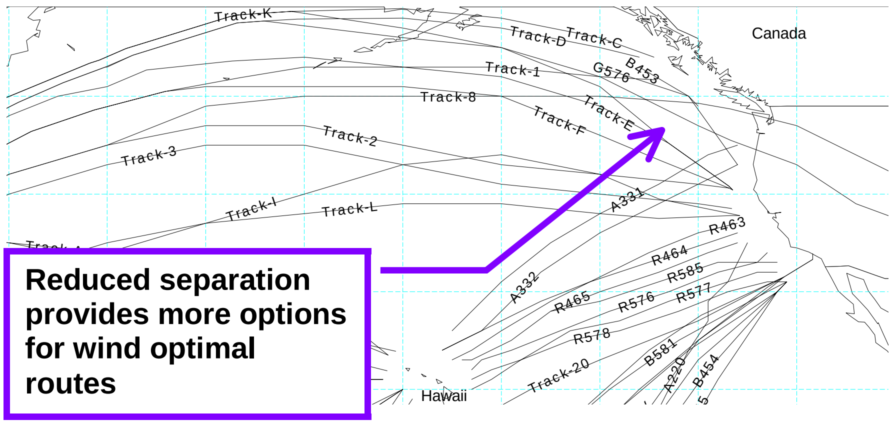
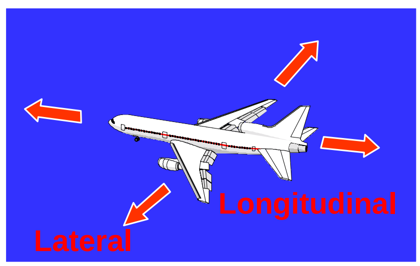
# ER-6:  Reduce Oceanic Separation

## 30 nm lateral and longitudinal (30/30) separation in the ocean.




### Background

- *Separation Standards Factors.*  Separation standards in a given airspace are a function of the communication, navigation, and surveillance capabilities available in a specific operating environment.  Safety analysis and operational judgement consider factors such as:  timeliness and reliability of controller-pilot communications, accuracy of aircraft navigation, the controller’s ability to determine potential separation loss, aircraft traffic density, and procedures for contingencies such as engine failure and weather deviations.

- *RNP Concept*.  The Required Navigation Performance (RNP) concept has been introduced in Pacific operations to standardize navigation.  For example, RNP-10 approved aircraft are equipped with navigation systems that can navigate within 10 miles of desired position with 95% probability.

- *Current Separation Standards.*  Currently, the minimum lateral separation applied by the FAA is:  120 nm in Atlantic and Caribbean/South American airspace, 60 nm in North Atlantic minimum navigation performance specification airspace, 50 nm between RNP-10 approved aircraft in Pacific airspace except in the Central Pacific where, due to convective weather, 100 nm lateral is applied south of 30N.

  Conventional longitudinal separation is 10 minutes (approximately 80 nm).  50 nm longitudinal separation is currently applied by South Pacific air traffic service providers having enhanced CNS/ATM systems, to aircraft approved for Controller Pilot Data Link Communications (CPDLC) and RNP-10 (10 nm/95% probability).

- *Current Deployment of ADS-A Systems.* Air Traffic Service Providers in New Zealand, Australia, and Tahiti use Automatic Dependent Surveillance-Address (ADS-A) systems in Pacific oceanic airspace. In addition, Fiji plans to deploy an ADS-A system in 2001 and a similar system is under operational testing in Tokyo oceanic airspace.
- *Status of Aircraft System Approvals*. The FAA and other civil aviation authorities have certified ADS-A, CPDLC and RNP capabilities on aircraft such as the B-747-400, B-777 and the A-340.

**Ops Change Description**

*30/30 Separation.* The ICAO Separation and Airspace Safety Panel has established standards for the implementation of 30 nm lateral and longitudinal separation that call for: direct controller-pilot communication via voice or datalink, aircraft navigation accuracy to RNP-4 (4 nm/95% probability) and ADS-A capability in the aircraft and at the oceanic center.

*FAA ADS-A/ATOP Program.* The Advanced Technology and Oceanic Procedures (ATOP) program will deploy ADS-A capability in airspace where the FAA provides oceanic air traffic services. FAA oceanic centers currently offer Controller-Pilot Datalink Communication (CPDLC) service to equipped aircraft.

The ATOP system will enable the application (to properly equipped aircraft) of 50 nm longitudinal separation (extended use) and 30 nm lateral and longitudinal separation. These reduced separation standards will increase oceanic airspace capacity and aircraft time/fuel burn efficiency. ATOP will also improve the safety of oceanic operations by giving controllers enhanced tools to track aircraft progress and identify potential aircraft conflicts and problems.

**Benefits, Performance and Metrics**

- *Fuel/Time Savings.* Provides equipped users with fuel and time savings, more reliable and optimum routes and greater likelihood of timely granting of requests for clearance changes.
- *Flown as Filed.* Percentage of flights cleared as filed will increase. As a result, fewer altitude change or speed commands are needed because of the pilot’s ability to maintain spacing and the smaller separation “bubble” required around each aircraft.
- *Route Efficiency.* The number of routes moved closer to great circle or minimal wind route are expected to increase, resulting in the reduction of fuel load as route reliability increases.
- *Block Time Index.* Lateral reductions have been shown to reduce fuel consumption, which has routinely been taken by carriers in the form of block time savings.
- *Step Climbs.* Increase in user requests granted for procedures such as step climbs.
- *Safety Benefit/Collision Risk Reduction.* Enhanced ATOP surveillance capabilities combined with CPDLC communication enhancement will enable controllers to detect and intervene when aircraft deviate from cleared track or altitude and mitigate the risk of conflict with other aircraft.

## Scope and Applicability

- *Enhanced Surveillance in FAA Controlled Oceanic Airspace.* ADS-A will provide enhanced surveillance capability in Oakland, Anchorage, and New York oceanic airspace. ADS-A will enable the FAA to apply 30 nm lateral and longitudinal separation in that airspace.
- *Initial Goals/Dates.* Initial FAA goals are to implement 30 nm lateral and longitudinal (30/30) separation in Oakland controlled South Pacific airspace by 2005. This will be expanded to additional FAA controlled airspace as ADS-A deployment plan progresses.
- *Aircraft Fleet Equipage.* 30/30 separation and enhanced surveillance will only apply to appropriately equipped aircraft. Aircraft system requirements for 30/30 include CPDLC, RNP-4 approval, and ADS-A.
- *Contingency Procedures.* Contingency procedures will be developed for loss of communications, ADS-A or aircraft RNP-4 capability, aircraft system malfunctions, and weather deviations.

## Key Decisions

- *Operator Commitment to Oceanic Datalink.* User community must commit to unified data link evolution.
- *Cost/Safety Benefits.* To increase levels of aircraft equipage, operators must be convinced of cost/benefit and safety enhancements gained by ATOP deployment.
- *Aircraft Fleet Equipage.* To maximize ADS-A benefits, aircraft fleet equipage with CPDLC, RNP-4 and ADS-A capabilities must increase significantly. (Currently approximately 20% of oceanic flights are so equipped.)
- *Plan for Accommodation of Mixed Equipage.* Plan to accommodate aircraft with mixed CNS capabilities for an extended period of time must be developed and accepted.

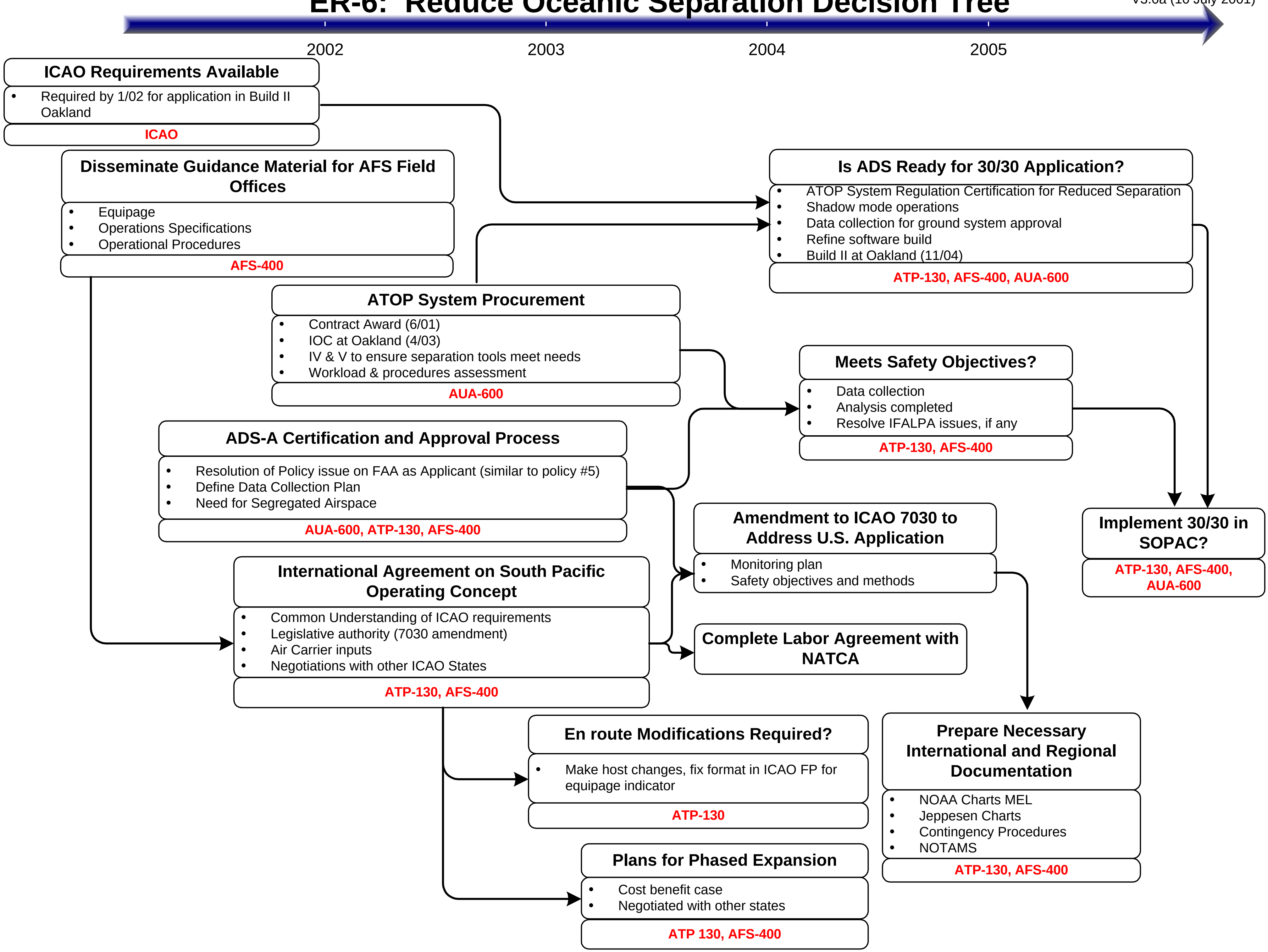
## Key Risks

- *ADS-A System Deployment.* ADS-A system must progress without significant delay to IOC and Build II at Oakland ARTCC.
- *ADS-A System Performance.* ADS-A system must perform at prescribed levels of reliability and availability.
- *Staff Resources.* Adequate experience and staffing levels to support national and local procedures development, operator approval, and transition of systems for the separation standards in ocean and remote areas.
- *AFS Resources.* Availability of Flight Standards specialist resource to assess ADS-A system performance and capability to mitigate collision risk and enable aircraft separation reduction.

- *ICAO Requirements.* Final ICAO Requirements for 30/30 application must be available by January 2002 for inclusion in ATOP Build II system requirements.
- *30/30 Implementation Requirements.* Acceptance of adequacy of 30/30 implementation requirements such as safety analysis, ground and aircraft capabilities, and contingency procedures.
- *Operator Commitment to Aircraft Equipage.* Cost/ benefit and safety analysis to advocate fleet advanced CNS equipage beyond current approximate 20% level.
- *Revision of ICAO Regional Policy Documents.* Publication of 30 nm lateral and longitudinal standards in ICAO Asia and Pacific Regional Supplementary Procedures.
- *Aircraft Equipage Mandate*. Long term plan to mandate aircraft equipage with advanced CNS capabilities must be developed.

# ER-6: Reduce Oceanic Separation Decision Tree

V3.0a (10 July 2001)



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# Solution: Accommodate User Preferred Routing

En Route Congestion
Solutions
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Benefits
Key Decisions
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Responsible Team

Today, controllers have a view of the airspace that is bounded by the sector that they control. Fixed airspace structures used to organize flows and create predictable intersections are necessary for moment-to-moment control. These structural limitations in some cases result in under utilization of some airspace even as adjacent airspace may be congested. A more strategic look across multiple sectors with conflict detection tools and the flexibility granted the users in the national route program should decrease the concentration of flights. However, in some cases the structure may actually enhance the efficient use of airspace. A careful balance of sufficient, predictable flows and controller look-ahead is required to ensure that flexibility does not simply shift the point of congestion to other sectors.

**Key Dates**

| | |
|---|---|
| Deploy URET at Seven FFP1 Sites | 2002 |
| Comprehensive Revisions to Restrictions (Ongoing) | 2003 |
| Deploy URET at Nine Additional Sites | 2004 |
| Evaluate PARR/D2/EDA | 2004 |
| Deploy URET at Four Additional Sites (Post 05) | 2005 |

# Responsible Team: Accommodate User Preferred Routing



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**Other Websites**

RTCA Website

Free Flight Program Office



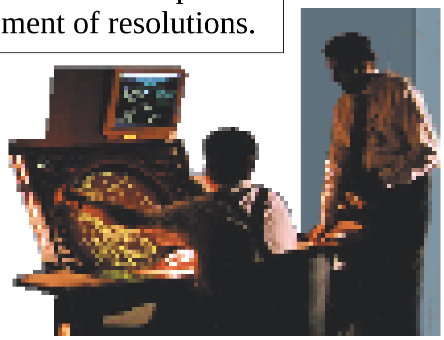
Please send your comments to nas-evol@mitre.org

**This page was last updated on May 30, 2001**

# ER-7: Accommodate User Preferred Routing

## Optimize airspace use by providing decision support tools to controllers.

Strategic planning by controllers makes use of automated prediction of separation conflicts and assessment of resolutions.



Controllers manage assigned meter times with the use of automation projections.

Options for conflict resolution are provided for controller consideration and decisions.

### Background

Today, controllers have a view of the airspace that is bounded by the sectors for which they have jurisdiction. This view limits the options available to the controller to solve problems. In addition, a fixed route structure is used to organize the airspace, providing controllers with predictable points where conflicts may arise. This fixed route structure allows controllers to maintain a three-dimensional view of the traffic situation. In some cases, however, this results in aircraft being separated from airspace. In the current environment, flow constraints (e.g., Miles-in-Trail restrictions, ground delay programs, re-routes) are used to avoid situations where the number of aircraft being controlled by an en route sector controller is beyond the controller's ability to provide separation services. This also results in the users being constrained in their choice of flight paths.

### Ops Change Description

By providing Air Traffic Management decision support capabilities to the sector, controllers are able to see beyond their own sector boundaries, increasing the options to solve problems as well as increasing the likelihood that more efficient services can be provided. This will be accomplished through the addition of strategic management tools that complement the tactical control techniques used to maintain safety. These strategic tools provide advisory information about routes and/or altitude options that can avoid conflicts and weather situations. The specific decision support capabilities are:

- ER-7.1: *Conflict Identification and Planning*, which assists controllers in the prediction of aircraft-aircraft and aircraft-airspace conflicts and which has capabilities for controllers to construct and assess alternatives. The User Request Evaluation Tool (URET), being developed and deployed under Free Flight Phase 1 and 2, will provide these capabilities.

- ER-7.2: *Metering and Merge Planning*, which provides a metering plan to TMCs and provides information to controllers to quantify the differences between assigned meter times and the times that aircraft are projected to cross a meter fix. The Traffic Management Advisor (TMA), being developed and deployed under Free Flight Phase 1 and 2, will provide these capabilities at some locations. An enhanced version of TMA, which can be used at additional locations, is currently in research.
- ER-7.3: *Conflict Resolution and Planning Aids*, which are used by controllers to generate proposed solutions to aircraft-aircraft and aircraft-airspace conflicts and to identify instances where a more direct route will result in user savings. A resolution capability - Problem Analysis, Resolution, and Ranking (PARR) and a direct routing aid - Direct-to (D2) are currently being researched.

From the user perspective these capabilities will support their ability to fly routes that are defined by points in the airspace (latitude/longitude/altitude), with fewer restrictions caused by the structure of the airspace.

**Benefit, Performance and Metrics**

- Reduction in static airspace restrictions.
- The total miles flown through a center will decrease.
- Hourly flow by ARTCC and Sector will be increased.
- Fewer low-altitude holds will be invoked.
- Fly as filed percentage (including altitude) will increase.
- User-requested re-route percentage being granted will increase.

## ER-7.1 Conflict Identification and Planning

Decision support tools assist the controller in detecting conflicts and assessing potential changes to the aircraft's path.

**Scope and Applicability**

- URET can be applied to all en route airspace. The benefits URET provides depend on the traffic levels and complexity that sector controllers have to deal with. For greatest benefit, URET should be available in contiguous airspace.
- By the end of FY 02, FFP1 introduces URET to five additional centers (Cleveland, Chicago, Kansas City, Washington and Atlanta) and replaces the prototype at Memphis and Indianapolis Centers.
- Long-Term: FFP2 will expand URET to Minneapolis, Denver, Albuquerque, Fort Worth, Jacksonville, New York, Houston, Boston and Miami centers. The FFP2 program office has not established URET schedules, but the deployments will be complete prior to 2005, with initial daily use at four sites in FY 03 and five sites in FY 04. Deployment to

Salt Lake City, Oakland, Los Angeles, and Seattle centers is planned after 2005. Schedules for the last four sites have not been established.

**Key Decisions**

- None identified.

**Key Risks**

- None identified.

## ER-7.2 Metering and Merge Planning

Decision support tools provide the TMC with a metering plan and the controller with information on the required delays for each aircraft (also see AD-4.2).

**Scope and Applicability**

- TMA (Traffic Management Advisor) is applicable for airports where arrival-demand regularly exceeds capacity.
- TMA-SC (Traffic Management Advisor –Single Center) near-term and mid-term locations include: ZFW-DFW (complete), ZMP-MSP (complete), ZDV-DEN (complete), ZMA-MIA (FY01), ZOA –SFO (FY01), ZLA-LAX (in initial daily-use), ZTL-ATL (FY01), and ZAU-ORD (FY02).
- Additional arrival sites will require site specific adaptation. FFP2 plans to deploy TMA-SC to support arrivals at the following airports: ZME-MEM, ZKC-STL, ZID-CVG, and ZHU-IAH. Deployment order and schedule have not been finalized, but the current plan is to deploy to 1 site in FY 03, 2 sites in FY04, and 1 site in FY 05. Expansion to additional sites may include supporting arrivals to MCO, CLT, SEA, SLC, PHX, and LAS.
- TMA-MC (Traffic Management Advisor –Multi Center) will enhance TMA to work in areas where the airport is close to the center boundaries and where arrival flows interact with flows to other airports. RTCA recommended TMA for several sites that require TMA-MC capability, these include Washington area airports, N90 airports, PHL, DTW, SDF, BOS, and PIT. NASA is developing TMA-MC with emphasis on PHL airspace; this capability should be ready for evaluation in FY 03.

**Key Decisions**

- Priorities for TMA deployments beyond the current recommendations.

**Key Risks**

- NASA is currently researching TMA-MC. Implementation is dependent on the success of this research and on NASA participation in technology transition.
- New York and Philadelphia redesign activities will result in changes to TMA adaptation and therefore work in these areas needs to be coordinated.

## ER-7.3 Conflict Resolution and Planning Aids

Decision support tools will assist the controller's ability to resolve conflicts and to generate direct routes.

**Scope and Applicability**

- En route conflict resolution aids expand on the conflict probe capability provided by URET CCLD.
- Research is currently underway on a direct-to tool that identify instances where a more direct route will result in user savings and on conflict resolution aids that assist the controller in generating solutions. These capabilities should undergo full scale evaluation in FY02-04. A spiral development approach will allow some capabilities to be implemented early.

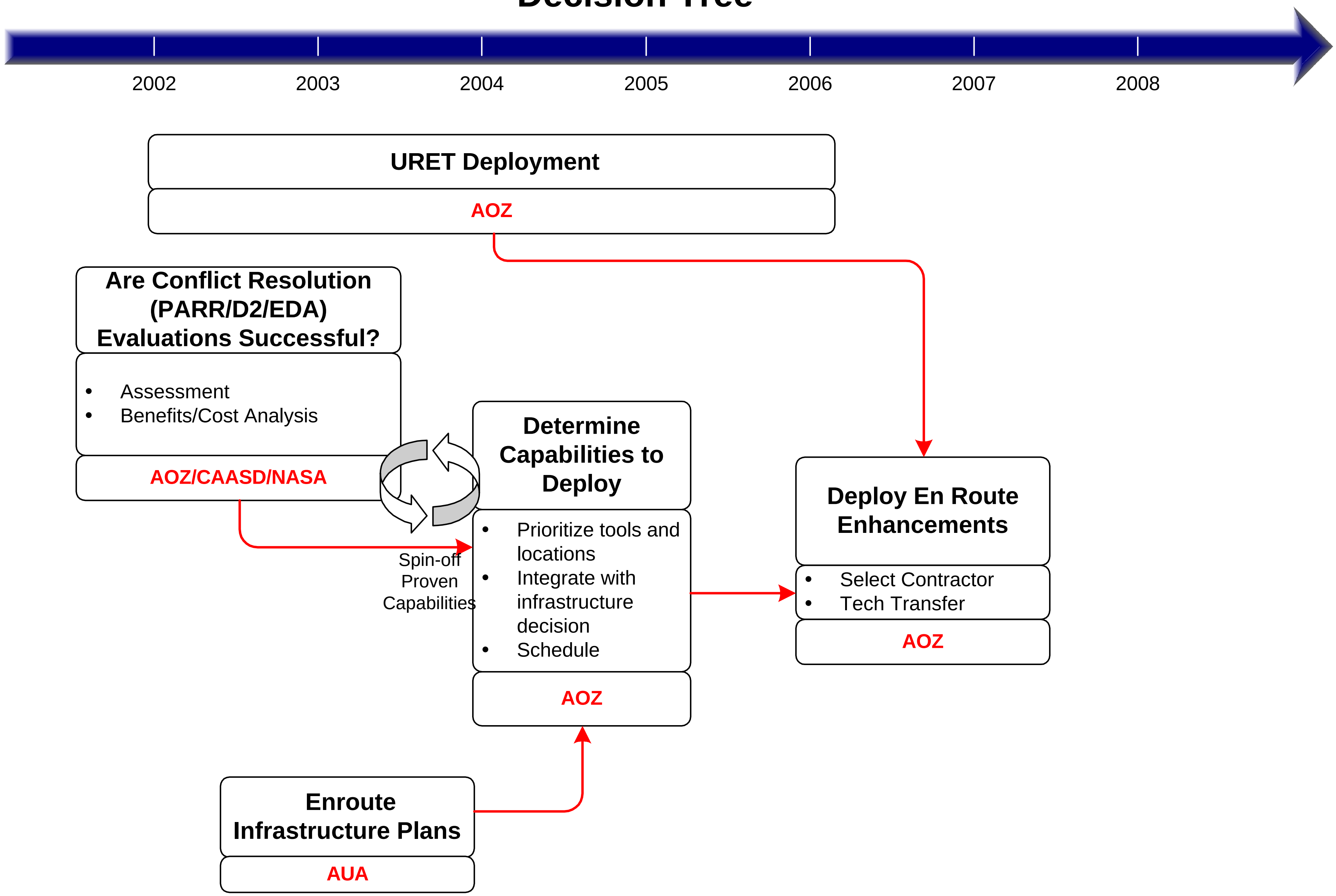
**Key Decisions**

- None identified.

**Key Risks**

- MITRE/CAASD is currently researching conflict resolution aids (PARR - Problem Analysis, Resolution, and Ranking). Implementation is dependent on the success of this research and on CAASD participation in technology transition.
- NASA is currently researching a direct-to (D-2) capability. Implementation is dependent on the success of this research and on NASA participation in technology transition.

# ER-7: Accommodate User Perferred Routing Decision Tree



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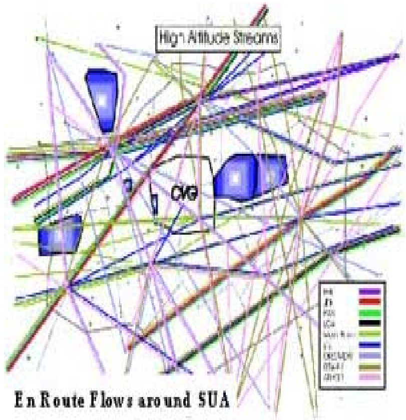
# Solution: Provide Access to Restricted Airspace

En Route Congestion
Solutions




The availability of special use airspace (primarily airspace reserved for military use) is often not known in time to be of any value as an alternative route for civilian flights. More effective distribution of this information to service providers, pilots and air carriers will increase the practical use of this airspace as a means to avoid congested areas. Negotiation among the stakeholders and trials of standing plans for access to specific areas such as the Buckeye military area and the Virginia Capes area are underway.

**Key Dates**

| | |
|---|---|
| Agreement on Procedures/Practices | 2002 |
| Upgrade to MAMS | 2004 |

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Full Schedule
Responsible Team

# Responsible Team: Provide Access to Restricted Airspace



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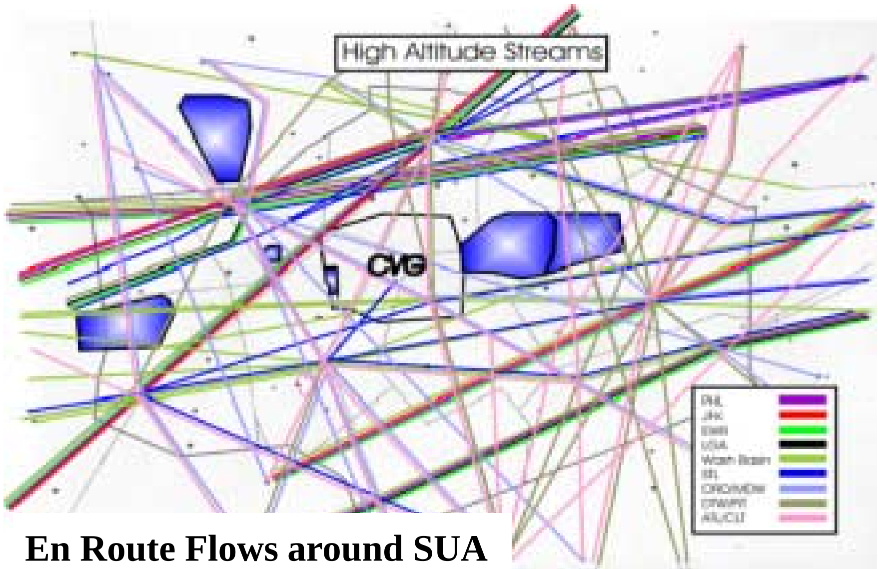
ATA-1

**Working Forums**

**Other Websites**

# ER-8:  Provide Access to Restricted Airspace

## Provide more efficient and flexible routing through dynamic use of special-use airspace when available and appropriate.




En Route Flows around SUA

### Background

Information on the availability of special use airspace (SUA) for civilian flights is often not timely or is limited to real-time announcements.  Timely schedules for the SUA and dynamic use of the SUA information will result in enhanced route flexibility.

### Ops Change Description

The operational change involves procedures to provide more effective distribution of SUA information to service providers, pilots, and other airspace users.  The information will foster collaboration among stakeholders and increase flexibility and access.  Decision support tools will improve information processing, planning, scheduling, and routing.

### Benefits, Performance and Metrics

- Improved flight efficiency and reduced flight-leg length when authorized to transit the airspace.

**Scope and Applicability**

Near-Term:

- The FAA, military, and civilian users are exploring methods of sharing information about SUA schedules and utilization to increase civilian access. Operational trials are underway in Florida and Texas to evaluate these proposed collaborative actions.
- The FAA is working with the military to obtain more real-time access to several pieces of special use airspace. Each effort is being pursued with the military on a case-by-case basis.

Mid-Term:

- The FAA is using and evolving the Special Use Airspace Management System (SAMS), and developing the interface between SAMS and Military Airspace Management System (MAMS). These systems will provide schedule and use information to all en route centers and the ATCSCC.

**Key Decisions**

- The military wants to continue to work cooperatively with FAA and civilian users to provide access to airspace when not in use by the military.
- Procedures for sharing SUA availability information are being developed, based on recommendations from RTCA Special Committee 192 operational trials. This information is available via SAMS. The military and the FAA are determining the process for improving public dissemination of the information (e.g., improving use of Internet).

**Key Risks**

- The military will want to maintain its flexibility in use of airspace and not lose airspace given their defense mission and ground investments.
- Definition of procedures and process for sharing SUA availability information.
- Maintainability of SAMS and supporting automation.
- Limited interoperability between SUA information sharing capabilities (SAMS, MAMS, etc.).
- Lack of definition of needed improvements or upgrades to automation systems to support near real time SUA information processing, planning, scheduling, and routing.

# ER-8: Provide Access to Restricted Airspace Decision Tree

V3.0 (30 May 2001)