Federal Aviation Administration

Advanced Operational Concepts Division

**ANG-C4 Research Plan**



Version 3.1

February 22, 2013

**Introduction**

## Objective Statement

The purpose of this document is to provide an overview of research topics for the Advanced Operation Concepts Division, ANG-C4, to perform in the 2013, 2014, and 2015 fiscal years. This includes follow-on work to existing ANG-C4 research as well as entirely new topics. The ANG-C4 Research Plan will be used to align priorities, develop a long-term vision and solicit feedback from senior management.

This document is a draft summary and is intended for down-selecting the final research proposals for submission to the ANG Chief Scientist. After the down-selection is made, more detailed descriptions will be provided in the final document.

## Description of the Document

This document lists ANG-C4 research proposals for future NextGen funding. Additional ANG-C4 research projects may be ongoing with external funding or have sufficient existing NextGen funding to complete their projects. Each research proposal has been detailed using a standard template. The proposals start with the project name, a point of contact, and a project status. The point of contact listed at the top of the research descriptions does *not* imply that this individual is the source of the proposed research but that person is a potential primary researcher. Research which has been previously funded is indicated as “Ongoing” whereas new or derivative research projects are shown as “New Work”. The executive summary provides a brief description of the research. More comprehensive descriptions include text about related projects the benefit of the work, and an overview of the project.

The Funding & Activities Table for each topic, as shown in Table 1, is organized and colored based upon the fiscal year funding request. Start dates are not listed but activities can be approximated to start in the year of funding. The research is organized into fiscal year requests to also provide a decision point for continuing the project. The previous year’s activities and outcomes will inform the decision to continue the research project. **As with all budget estimates and project plans, these activities and funding requests are subject to change based upon changes in the project scope and new information**.

Table : Sample Funding & Activities Table

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 |  |  |  |
| FY13 | * Develop initial requirements | FY14 | $200,000 |
| FY14 | * Conduct fast-time simulation | FY15 | $800,000 |
| FY15 |  |  |  |

References at the end of the research proposal provide supporting information. The associated Operational Improvements link the research to overarching agency goals. Sources include reference documents and research lead interviews where the need to perform the research was identified. Research proposals are also linked to Portfolios as defined in the NextGen Segment Implementation Plan v5.0.

## Development Methodology

Areas for potential research were identified by reviewing NextGen strategic planning documents, the NAS Enterprise Architecture, and related documents which are listed in Table 2, below. In addition, inputs were received through interviews with representatives from ANG-C and ANG-D.

Table : Documents Reviewed

|  |
| --- |
| Name |
| 2012 National Aviation Research Plan (NARP) |
| Capital Investment Plan (CIP) |
| Concept Working Group Meeting Minutes |
| Concept Working Group SOP |
| Destination 2025 |
| DOT Office of Inspector General Report on Metroplex |
| JPDO’s NextGen Unmanned Aircraft Systems Research, Development and Demonstration Roadmap, Version 1.0 |
| JPDO’s FOC of the Future report July 2012 |
| Mid-Term ConOps Annotated Outline |
| Mid-Term Scenarios |
| NAS Enterprise Architecture (EA) Support Activities, Decision Points & Mid-Term Overview and Summary (AV-1) |
| New Global Air Navigation Plan (GANP) 2014-2016 |
| NextGen Segment Implementation Plan (NSIP) 4.0 |
| NextGen Segment Implementation Plan (NSIP) 5.0 Draft and related Briefings |
| Operational Gap Analysis v2.0 final 9/30/2011 |
| Response to Research Engineering & Development Advisory Committee (REDAC) 10/04/2012 |
| RTCA Task Force 5 Recommendations |

## Research Alignment

The relationship of the research proposals to the NextGen implementation portfolios and solution sets are mapped in the table below. Research proposals are sorted by solution set and then cross referenced to portfolios. Half of the research topics align with the Trajectory-Based Operations or Arrivals/Departures at High-Density Airports solution sets.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Portfolio | | | | | | | | |
| Collaborative Traffic Management | Improved Surface Operations | Time-Based Flow Management | Improved Multiple Runway Operations | Improved Approaches and Low-Visibility Operations | Performance Based Navigation | On-Demand NAS Information | Separation Management | Other |
| # | **Research Proposal**  (Separated by Solution Set) |  |
| Solution Set: Initiate Trajectory-Based Operations | | | | | | | | | | | |
| 3 | Optimized Route Capability (ORC) Validation |  |  | x |  |  |  |  |  |  |
| 4 | Vertical Ascent & Descent Rate (VADR) |  |  | x |  | x |  |  |  |  |
| 5 | NextGen Trajectory Negotiation (NTN) | x |  | x |  |  |  |  |  |  |
| 6 | Dynamic Network Analysis (DNA) | x |  | x |  |  |  |  |  |  |
| 7 | PBN ConOps |  |  |  |  |  | x |  |  |  |
| 8 | Initial High Performance Routes |  |  |  |  |  | x |  |  |  |
| 9 | Dynamic High Performance Routes |  |  |  |  |  | x |  |  |  |
| 10 | Conflict Resolution Advisories |  |  |  |  |  |  |  | x |  |
| 11 | Special Activities Airspace Management |  |  |  |  |  |  | x |  |  |
| 12 | PBN in Flexible Route System |  |  |  |  |  | x |  |  |  |
| 14 | Datalink of Complex PBN Clearances in Support of 4D TBO |  |  |  |  |  | x |  |  |  |
| 23 | UAS Integration into the NAS |  |  | x |  |  |  |  | x |  |
| 24 | Space Vehicle Operations |  |  | x |  |  |  |  | x |  |
| Solution Set: Increase Arrivals/Departures at High Density Airports | | | | | | | | | | | |
| 1 | Integrated Arrival/Departure Control Service (IADCS) |  |  |  |  | x |  |  |  |  |
| 19 | Enhanced Departure Predictability for TFM (EDPT) |  |  | x |  |  |  |  |  |  |
| 20 | Statistical Methods for Departure Predictability (SMDP) |  |  | x |  |  |  |  |  |  |
| 21 | TMI Attribute Standardization (TAS) |  |  | x |  |  |  |  |  |  |
| Solution Set: Flexibility in the Terminal Environment | | | | | | | | | | | |
| 2 | Efficient Metroplex High Altitude Transition (EM-HAT) |  |  |  |  | x |  |  |  |  |
| 13 | Data Comm ConOps |  |  |  |  |  |  |  |  | Common Services |
| 15 | NextGen D-Taxi Services |  | x |  |  |  |  |  |  | Common Services |
| 16 | Remote Operations at Non-Towered Airports (RONA) |  | x |  |  |  |  |  |  |  |
| 17 | Advanced Applications of ADS-B In |  | x |  |  |  |  |  |  |  |
| Solution Set: Improve Collaborative ATM | | | | | | | | | | | |
| 18 | Integrated CATM ConOps | x |  |  |  |  |  |  |  |  |
| 22 | ERAM Controller Information Tool (ECIT) |  |  |  |  |  |  |  |  | Common Services |
| Solution Set: Other | | | | | | | | | | | |
| 25 | Mixed Equipage Research for Operational Concepts Validation |  |  |  |  |  |  |  |  | Policy |

Table : Research Proposal Alignment to Portfolios and Solution Sets

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**ANG-C4 Draft Research Plan**

Preliminary list of potential research topics to be considered for FY13 – FY15 work

**Legend**: = Approved = More Information Required = Deferred

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[3. Optimized Route Capability (ORC) Validation 5](#_Toc349299936)

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[8. Initial High-Performance Routes 15](#_Toc349299941)

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[10. Conflict Resolution Advisories (CRA) 19](#_Toc349299943)

[11. Special Activities Airspace (SAA) Use and Management 22](#_Toc349299944)

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[14. Datalink of Complex PBN Clearances in Support of 4D Trajectory Based Operations (TBO) 27](#_Toc349299947)

[15. NextGen D-Taxi Services 29](#_Toc349299948)

[16. Remote Operations at Non-Towered Airports (RONA) 31](#_Toc349299949)

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[21. TMI Attribute Standardization (TAS) 40](#_Toc349299954)

[22. ERAM Controller Information Tool (ECIT) 42](#_Toc349299955)

[23. Unmanned Aircraft Systems (UAS) Integration in the NAS 44](#_Toc349299956)

[24. Space Vehicle Operations (SVO) 46](#_Toc349299957)

[25. Mixed Equipage Research for Operational Concepts Validation 48](#_Toc349299958)

# Integrated Arrival/Departure Control Service (IADCS)

|  |  |
| --- | --- |
| Point of Contact & Organization: | Phil Bassett, ANG-C42 |
| Project Status: | Ongoing |

## Executive Summary

* Integrated Arrival/Departure Control Service (IADCS) developed a set of traffic management +
* tools that can be implemented in today’s infrastructure (no additional tools required) to maintain the continuity of air operations during periods of high volume and inclement weather
* Expand on work done in Atlanta to tailor, develop, and validate IADCS toolkit at a more complete site
* Fast track work to implementation

## Executive Direction

* Decision on this is still pending.
* The Chief Scientist has requested that AJV-73 be briefed on this proposal. If this has ATO support via AJV-73, then brief the new airspace clearing house for direction.

## Integrated Description

The Integrated Arrival/Departure Control Service (IADCS) concept offers an expanded set of traffic management tools that provide air traffic controllers with a means to maintain the continuity of air operations during periods of high volume and inclement weather, with minimal interruption of traffic flow. These tools can be used in today’s existing infrastructure to ease traffic constraints, reduce weather and volume related delays, and lower costs to all parties involved (airlines, air navigation service providers, facilities, and consumers).

Existing funding will allow for the validation of IADCS tool kits at Atlanta, a single OAP-35 site model – Phase 1 effort. These tools are anticipated to be transferred for preliminary implementation in early FY14 via OAPM. Additional funding will allow for the development and tailoring of the IADCS tool kits at other kinds of site – to evaluate the tools in a more complex environment. Phase II is looking at a multiple OAP-35 airport environment. Candidate sites for Phase II include Miami, DC metro, Chicago, or appropriate OAPM site. Phase III could focus on a multiple facility site such as the newly integrated control facility. Each phase would involve development and validation of the IADCS tool kits and preparation of a turnover package for implementation. We would study what effects the tools have on the system’s efficiency, capacity, safety, controller workload, situation awareness, and overall performance. The tools will be validated, benefits will be quantified using a model of existing airspace, and traffic data will be modeled on real time data.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY10 | Develop project strategy & initial metroplex integration | FY11 | $ 2,525,000 |
| Perform site selection and study plan | FY11 |
| Perform cognitive walkthrough | FY12 |
| Produce fast-time simulation report | FY13 |
| Produce HITL-1 Final Report | FY13 |
| Validate concepts of initial IADCS Toolkit at ATL: Final Report and turnover package for implementation | FY14 |
| FY13 | * Phase II – Develop IADCS toolset in a more complex (e.g., multi-facility) airspace environment (Miami, DC metro, Chicago, or appropriate OAPM site) | FY14 | $500,000 |
| FY14 | * Phase II – Validate IADCS toolset in a more complex (e.g., multi-facility) airspace environment (Miami , DC metro, Chicago or appropriate OAPM site) * Prepare turnover package of IADCS toolset for implementation in multi-facility space | FY16 | $1,400,000 |
| FY15 | * Phase III – Develop IADCS toolset in a newly integrated control facility | FY17 | $500,000 |
| FY16 | * Phase III – Validate IADCS toolset in a newly integrated control facility * Prepare turnover package of IADCS toolset for newly integrated control facility for implementation | FY19 | $1,400,000 |

## References

|  |  |
| --- | --- |
| Operational Improvement: | * 102146 Flexible Routing * 104122 Integrated Arrival/Departure Airspace Management * 108206 Flexible Airspace Management |
| Source: | * Research Lead Interviews - Phil Bassett (ANG-C42) |
| Portfolio | * Improved Approaches and Low-Visibility Operations |

# Efficient Metroplex High Altitude Transition (EM-HAT)

|  |  |
| --- | --- |
| Point of Contact & Organization: | Anton Koros, ANG-C43 |
| Project Status: | Ongoing |

## Executive Summary

* Develop and validate airspace design improvements and procedures changes to improve ingress/egress to Metroplexes and transitions to High-Performance Routes within current infrastructure
* Coordinate with IADCS and ORC project to look at transitions and efficiencies

## Executive Direction

* The Chief Scientist has requested more information about this topic
* Efficient Metroplex High Altitude Transition (EM-HAT) - (**FY13 RMP estimate $900K**)
* This would be TBFM work package #4 which is in FY17.
* Proposal as written is just airspace and this is not what is needed. What is needed is how tools (TBFM in particular) fit in and how either would actually be implemented in the NAS.

## Description

Metroplexes are among the largest sources of congestion and constraint in the NAS. As a result, delays cascade from these congested areas into High Altitude (HA) airspace and across the entire NAS. Using FY12 funding, ANG-C43 employed fast-time modeling tools to identify optimal implementation strategies to mitigate Metroplex-High Altitude coupling constraints using NextGen capabilities. The goal of this research effort is to develop new traffic flow procedures, airspace design improvements and other mechanisms to promote more efficient transition of air traffic between Metroplexes and HA airspace. One of the primary mechanisms for maximizing the benefits of the new route structure is supporting the integration of NextGen capabilities including Optimized Profile Climbs (OPCs) and Optimized Profile Descents (OPDs). The work will be focused on improving transitions within the current infrastructure. The results will aid in the development of improved operationally viable procedures aimed at metroplex /High Altitude synchronization as well as maximized capacity and user benefits.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 | Perform fast-time modeling to evaluate efficient metroplex/En Route transitions | FY14-Q1 | $690,000 |
| FY13 | * Evaluate procedures changes and airspace redesign to improve metroplex/En Route transitions within current infrastructure | FY15 | $900,000 |
| FY14 | Conduct HITL for evaluation of benefits and controller feedback | FY17 | $1,000,000 |
| FY15 | Conduct safety analysis and other final validation activities  Conduct final validation activities – HITL or Field Demonstration | FY19 | $1,600,000 |
| FY16 | Produce a turnover package of procedure changes and airspace redesigns to OAPM or En Route for implementation | FY20 | $500,000 |

## References

|  |  |
| --- | --- |
| Operational Improvement: | * 104124 – Use Optimized Profile Descent * 104117 – Improved Management of Arrival/ Surface/ Departure Flow Operations * 108209 – Increase Capacity and Efficiency Using Area Navigation (RNAV) and Required Navigation Performance (RNP) |
| Source: | * [Research](https://nasea.faa.gov/products/roadmap/main/display/14) Lead Interviews – Anton Koros, ANG-C43 * NAS EA – Support Activity 262: High Altitude Performance Based Airspace Validation Activities * NAS EA – Support Activity 101: Transition Strategy for High Altitude Performance-Based Airspace * NAS EA – Support Activity 262: High Altitude Performance Based Airspace Validation Activities * NAS EA – Decision Point 267: [Decision to proceed with High Altitude Trajectory Based Airspace Concept Phase 1](https://nasea.faa.gov/decision/main/display/267) |
| Portfolio | * Improved Approaches and Low-Visibility Operations |

# Optimized Route Capability (ORC) Validation

|  |  |
| --- | --- |
| Point of Contact & Organization: | Phil Bassett, ANG-C42 |
| Project Status: | Ongoing |

## Executive Summary

* Develop a suite of air traffic tools to provide continuous monitor constraints and generate optimal airspace, routing configuration, and other traffic management initiatives for consideration
* Information input from SWIM is a key enabler

## Executive Direction

* Estimated FY13 funding - **$800K**
* Supports funding only for fast-time modeling and further concept development
* Rob Hunt would need to provide money for the development of any prototypes that might be needed for concept validation

## Description

The ORC concept seeks ultimately to streamline the coordination and collaboration process by performing much of the front-end work (e.g., data processing and planning), and by generating optimal airspace and routing configurations that consider impact beyond the immediate and adjoining ATC facilities, and doing so in such a fashion as to allow for the timely and seamless implementation of changes.

The ORC assists with trajectory and flow management functions in a metroplex environment by optimizing airspace and route configurations based on demand and capacity. It will accomplish this by monitoring current operating conditions (e.g., traffic volume, airspace availability, weather forecasts, and staffing levels), and using this information to develop, when needed, alternative route structures and airspace allocations.

Air traffic control can also request that the ORC work to resolve a problem in a specific location such as asking for assistance in moving a flow for a local unexpected anomaly (e.g., pop-up localized weather cell or equipment outage). Finally, since many traffic flow adjustments often involve the redistribution of traffic flows outside the purview of a single ATC facility, the ORC will be able to coordinate with other facility ORC’s (e.g., share the same information and optimization plans) ensuring that the traffic pattern manipulations do not have any negative impact on either upstream or downstream operations.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY11 | * Perform ORC functional analysis | FY13-Q1 | $1,550,000 |
| * Develop ORC ConOps document | FY13-Q3 |
| * Develop ORC preliminary operational requirements | FY13-Q3 |
| FY12 | * Validate concepts via modeling and simulation report | FY14-Q1 | $690,000 |
| FY13 | * Develop procedures via player mapping, coordination with stakeholders, cognitive walkthrough, and fast-time modeling activities | FY14 | $800,000 |
| FY14 | * Perform HITL of ORC function with limited stakeholders/ functionality | FY16 | $800,000 |
| * Prototype & requirements development | FY16 | $1,500,000 |
| FY15 | * Perform HITL 2 with full stakeholders and functionality | FY17 | $1,000,000 |
| FY16 | * Conduct field demonstration #1 | FY18 | $1,000,000 |
| FY17 | * Conduct field demonstration #2 | FY19 | $1,000,000 |
| FY18 | * Perform final validation and develop turnover package | FY20 | $600,000 |

## References

|  |  |
| --- | --- |
| Operational Improvement: | * 101102 – Provide Full Flight Plan Constraint Evaluation With Feedback * 105207 – Full Collaborative Decision Making * 105208 – Traffic Management Initiatives With Flight Specific Trajectories |
| Source: | * Research Lead Interviews - Phil Bassett (ANG-C42) |
| Portfolio | * Time-Based Flow Management |

# Vertical Ascent and Descent Rate (VADR)

|  |  |
| --- | --- |
| Point of Contact & Organization: | Phil Bassett, ANG-C42 |
| Project Status: | New Work |

## Executive Summary

* Develop a means for representing and disseminating real-time vertical rate (vertical velocity) in all phases of flight. This research defines the need for ADS-B out to provide vertical rate. (Unlike position accuracy, vertical velocity accuracy is not transmitted in ADS-B messages)
* VADR should use a hybrid or blended calculation that could be derived from the Flight Management System (FMS), GNSS vertical rate, Air Data and Inertial Reference System (ADIRS), or an Inertial Reference Unit (IRU). ADS-B equipment should transmit hybrid vertical rate solutions as barometric vertical rates. ATC would utilize the solution for enhanced surveillance and separation.
* The use of accurate VADRs will decrease the volume of protected airspace resulting in better airspace utilization. Furthermore, it will allow better use, and verification of vertical RNAV/RNP procedures resulting in tighter, more precise RNP trajectories.
* Enhanced aircraft trajectory data provides ATC a substantially increased margin of safety for all vertical separation applications
* VADR could improve the sensitivity of conflict detection technology such as conflict probe and alert
* Enables other NextGen concepts – IADCS, FAM, OPD/OPCs, enhances RNP capabilities and procedures, increase utilization of existing PBN procedures, routes, and trajectories, verbally obtaining climb and descent rates from the flight-crew.

## Executive Direction

* Estimated FY13 Funding - **$0**
* Steve said that he has discussed this with others and they do not think that it will work with ERAM trajectory modeler. However, Steve agreed to do some further research, but not with OCVM funds.
* He will have Stephan Mondoloni look at it parametrically, and have Lockheed look at it too through their TBO trajectory synchronization work

## Description

The VADR concept provides ATC with a means for visually verifying an aircraft’s climb and descent rate without relying exclusively on pilot reporting. Currently, to obtain an estimate of the aircraft’s vertical speed, controllers must either calculate changes in altitude over time manually (by tracking changes in mode-c as displayed in the associated data block), or by VADR will provide this information to ATC in real time, and in doing so, will yield both operational and system benefits. For example, the ability to monitor and verify the vertical component of an aircraft’s movement in real-time will provide for better airspace and routing utilization by reducing the amount of protected airspace associated with the flight. This will be accomplished by allowing ATC to assign and monitor a vertical rate and then allow them to visually verify that the aircraft is complying with this rate in real-time.

Vertical compliance monitoring could greatly improve current NextGen initiatives such as RNP established procedures, optimum profile descents, optimum profile climbs, Integrated Arrival Departure Control Service, etc. and increase the frequency of usability. This also enables future Next Gen procedures and designs that would capitalize on the VADR capability.

VADR will also improve the sensitivity of conflict detection technology (e.g., conflict probe and conflict alert) by providing real time updates of the vertical component thus, allowing for more accurate predictions of the flight’s trajectory. This should also result in a reduction of phantom alerts.

It will result in better use, and verification of vertical RNAV procedures resulting in tighter, more precise RNP trajectories. This will be especially true for those aircraft equipped with the means to directly deliver the vertical component to ATC (e.g., equipped with ADS-B out with a vertical component reporting capability). Tighter RNP procedures will ultimate lead to increased throughput and reduced costs associated with delay and extended flight paths.

## Activities & Funding

| **FY$** | **Activity** | **Finish Date** | **Funding** |
| --- | --- | --- | --- |
| FY13 | * Perform Exploration of concept feasibility and preliminary benefits analysis | FY14 | $500,000  $500,000 |
| * Perform impact analysis of using VADR in new exploration of NextGen applications and procedures and separation management |  |  |
| FY14 | * Review flight deck / ground compatibility * Conduct functional analysis of avionics and ATC equipment configurations necessary to support VADR | FY15 | $400,000 $400,000 |
| * Review and analyze ATC procedures associated with VADR | FY15 | $400,000 |
| FY15 | * Draft a preliminary set of requirements for VADR * Validate initial VADR preliminary requirements | FY16  FY16 | $400,000 $500,000 |

## References

|  |  |
| --- | --- |
| Operational Improvement: | * 102146 - Flexible Routing * 104122 - Integrated Arrival/Departure Airspace Management * 104124 - Use Optimized Profile Descent * 105208 – Traffic Management Initiatives with Flight Specific Trajectories * 102123 – ADS-B Separation * 102137 – Automation Support for Separation Management |
| Source: | * Research Lead Interviews - Phil Bassett (ANG-C42) |
| Portfolio | * Initiate Trajectory-Based Operations |

# NextGen Trajectory Negotiation (NTN)

|  |  |
| --- | --- |
| Point of Contact & Organization: | Kevin Hatton, ANG-C4 |
| Project Status: | Ongoing |

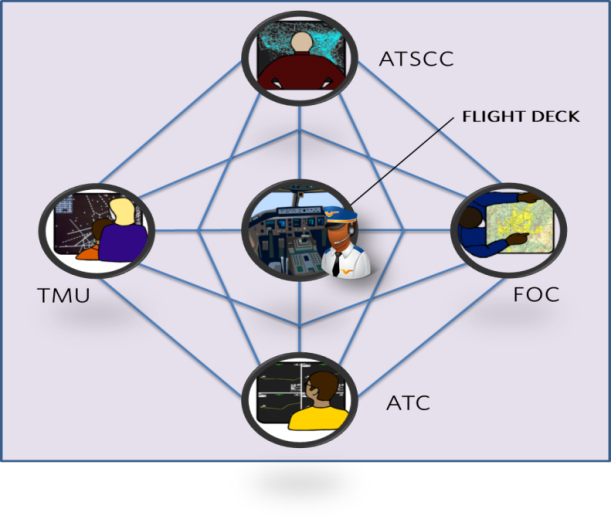
## Executive Summary

* NTN will provide the methodology for performing real-time trajectory negotiationfor trial planning, coordinating, issuing, and accepting or rejecting trajectory changes (reroutes) in real –time
* Existing trajectory negotiation tools will be modified or developed as appropriate, utilizing defined research activities, to implement the NTN concept

## Executive Direction

* Chief Scientist supports some level of effort for Conops development.
* Development of Concept of Operations approved at $450K.
* Estimated FY13 Funding - **$450K**
* More coordination needed for the request to develop a prototype/update electronic negotiation tools to include FOC for trajectory negotiation at $800K. Coordination has begun with Rob Hunt of ATO (AJV) who indicated that more coordination is needed to right size the effort and possibly tie it to AATS. Also need to understand relationship to airborne CACR.
* Additional coordination with Rob Hunt and Pat Somersall is pending.

## Description

As part of Flow-Based Trajectory Management (FBTM) research, NASA Ames has developed and tested electronic negotiation tools and procedures for trial planning, coordinating, issuing, and accepting or rejecting trajectory changes (reroutes). NASA research results have demonstrated that controllers and traffic managers have found these tools to be beneficial. JPDO published the FOC of the Future report in July, 2012, wherein they identified additional desired research that would facilitate the inclusion of FOC participants in airborne trajectory negotiation. This research area requires analysis of the appropriate methods and time horizons for such negotiation (i.e. which entities coordinate, in what order, and at what temporal distance from the anticipated event).

Additionally, NTN research will analyze available systems and technologies for trajectory negotiation (including FAA, FOC, and avionics systems), and methods for allocating constrained NAS resources through the trajectory negotiation concept. NTN cognitive walkthroughs and HITLs will contribute to the development of an NTN Concept of Operations that defines actors, methods, and procedures for implementing NTN. Existing trajectory negotiation tools will be modified or developed as appropriate, utilizing defined research activities, to implement the NTN concept. As a result, NTN will provide the methodology for performing real-time trajectory negotiationfor trial planning, coordinating, issuing, and accepting or rejecting trajectory changes (reroutes) in real –time.

**Activities & Funding**

| **FY$** | **Research Activity** | **Finish Date** | **Funding** |
| --- | --- | --- | --- |
| FY13 | * Incorporate FOCs into Simulation Platform | FY14 | $250,000 |
| * Conduct NTN Concept Development Simulation | FY14 | $500,000 |
| * Develop NTN ConOps | FY14 | $450,000 |
| * Develop procedures including cognitive walkthroughs | FY14 | $500,000 |
| * Develop prototype/update electronic negotiation tools to include FOC for trajectory negotiation | FY15 | $800,000 |
| * Conduct HITL #1 incorporating FOCs to facilitate development of NTN ConOps | FY15 | $1,500,000 |
| FY FY14 | * Utilize FOC/NextGen Flight Data Exchange (FNFDE) ConUse to define/expand Trajectory Data Exchange Elements | FY15 | $350,000 |
| * Update NTN ConOps | FY16 | $100,000 |
| * Continued to develop prototype and requirements | FY16 | $750,000 |
| * Conduct HITL #2 to validate ConOps | FY16 | $1,050,000 |
| FY15 | * Perform field demonstration # 1 | FY17 | $3,000,000 |
| FY16 | * Perform field demonstration # 2 | FY18 | $3,000,000 |
| FY17 | * Develop technical transfer package including prototype, requirements, draft procedures, and ConOps | FY19 | $500,000 |

## References

|  |  |
| --- | --- |
| Operational Improvement: | 104105 - Automated Support for Trajectory Negotiation  102146 - Flexible Routing  105207 - Full Collaborative Decision Making  105208 - Traffic Management Initiatives with Flight Specific Trajectories  101102 - Provide Full Flight Plan Constraint Evaluation with Feedback  105302 - Continuous Flight Day Evaluation  104126 - Trajectory-Based Management - Gate-to-Gate |
| Source: | Research Lead Interviews – Kevin Hatton (ANG-C4)  REDAC NAS Operations Subcommittee – Finding 2  Operational Gap Analysis v 2.0, Gap 27: Trajectory Negotiation  JPDO’s FOC of the Future report |
| Portfolio: | Collaborative Air Traffic Management |

# Dynamic Network Analysis (DNA)

|  |  |
| --- | --- |
| Point of Contact & Organization: | Kevin Hatton, ANG-C4 |
| Project Status: | Ongoing |

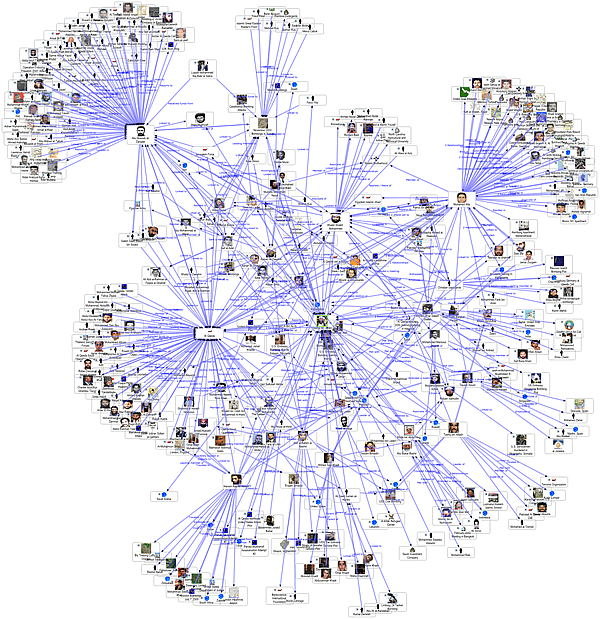
## Executive Summary

* A capability will be developed to integrate data from a NAS simulation platform with the DNA model, allowing robust, integrated analysis of NAS traffic flows and the underlying trajectory negotiation activities, supporting NTN, TBO, and CATM
* This research will result in refinement of the DNA model of the NAS, with detailed decomposition of NAS element nodes into individual actors and systems

## Executive Direction

* Approved to continue existing research efforts. Funding of model enhancement is approved at **$550K**.
* Support to incorporate greater fidelity for NAS Actors

## Description

Dynamic Network Analysis (DNA) varies from traditional social network analysis in that it can handle large dynamic multi-mode, multi-link networks with varying levels of uncertainty. DNA, like quantum mechanics, is a theory in which relations are probabilistic, acts of measurement change the network, movement in one part of a network propagates throughout the entire system, and so on. However, unlike quantum mechanical atoms, DNA nodes can learn. Dynamic Network Analysis focuses on advancing our understanding of social networks through DNA.

Current research (FY12 Funded) focuses on the development of a multi-mode, multi-level network assessment and analysis tool (DNA), which will be used for comparing and contrasting organizational interactions in the National Airspace System (NAS). The resulting Dynamic Network Analysis (DNA) model will be used to glean useful insights on the relative importance and temporal relationships between the various nodes (actors) in the network. Its initial focus will be to explore these relationships with respect to tactical (en-route) re-routes and will facilitate a contrast and comparison between today’s operations and those anticipated under NextGen with digital communications (i.e., Data Comm).

Additional research opportunities include further refinement of the DNA model of the NAS, with detailed decomposition of NAS element nodes into individual actors and systems. The DNA model will be utilized to assist in defining links, modes, and timing of communications between the actors and systems identified through NTN research. A capability will be developed to integrate data from a NAS simulation platform with the DNA model, allowing robust, integrated analysis of NAS traffic flows and the underlying trajectory negotiation activities.

 = Approved

## Activities & Funding

| FY$ | Research Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 | * Develop Dynamic Network Analysis (DNA) – NAS model | FY13 | $500,000 |
| FY13 | * Enhance DNA model to incorporate greater fidelity of FOCs and NAS actors. | FY14 | $550,000 |
| * Develop a translator which enables linking simulated scenario outputs as DNA inputs for detailed analysis of systemic network impacts of known or anticipated high value constraints. | FY14 | $150,000 |
| FY14 | * Validate the tool via modeling and simulation | FY15 | $300,000 |
| FY15 | * Develop technical transfer package including prototype, requirements, draft procedures, and ConOps | FY17 | $500,000 |

## References

|  |  |
| --- | --- |
| Operational Improvement: | * 104105 -Automated Support for Trajectory Negotiation * 102146 - Flexible Routing * 105207 - Full Collaborative Decision Making * 105208 - Traffic Management Initiatives with Flight Specific Trajectories * 101102 - Provide Full Flight Plan Constraint Evaluation with Feedback * 105302 - Continuous Flight Day Evaluation * 104126 - Trajectory-Based Management - Gate-to-Gate |
| Source: | * Research Lead Interviews – Kevin Hatton (ANG-C4) * REDAC NAS Operations Subcommittee – Finding 2 * Operational Gap Analysis v 2.0 * JPDO’s FOC of the Future report |
| Portfolio: | * Collaborative Air Traffic Management |

# Performance-Based Navigation (PBN) ConOps

|  |  |  |
| --- | --- | --- |
| Point of Contact & Organization: | Marc Buntin, ANG-C4 |  |
| Project Status: | New Work |  |

## Executive Summary

* Develop a service-level ConOps for PBN

## Executive Direction

* The Chief Scientist explained that OCVM does not need to fund this work because AJV-70 is working on it in the OSED work.

## Description

Performance-Based Navigation (PBN) is a framework for defining navigation performance specifications for an aircraft along a route, during a procedure, or in airspace. These navigation performance specifications have been defined and have specific operational performance requirements. PBN provides a simple basis for the design and implementation of automated flight paths, as well as for airspace design, aircraft separation, and obstacle clearance. Despite the fact that PBN is one of the foundational building blocks of NextGen, many PBN procedures have been produced but are underutilized. This low utilization can be attributed to the lack of a clear, unified vision of how PBN will be used within air traffic management, and the benefits it will provide to industry stakeholders. To help remedy this, ANG-C4, working with ANG-C5, AJV and AFS, will develop a Level 2 (Service) ConOps for PBN that clearly describes the operational change and impact on the stakeholders, defines concept objectives, and identifies gaps or overlaps in concept coverage.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 |  |  |  |
| FY13 | * Produce draft Level 2 PBN ConOps | FY14 | $400,000 |
| FY14 | * Produce final Level 2 PBN ConOps | FY14 | $100,000 |
| FY15 |  |  |  |

## References

|  |  |  |
| --- | --- | --- |
| Operational Improvement: | * 108209 – Increase Capacity and Efficiency Using Area Navigation (RNAV) and Required Navigation Performance (RNP) | |
| Source: | * Research Lead Interviews – Rich Lanier (ANG-C41) * Bruce DeCleene (AFS-400) * John Maffei and Andras Kovacs (ANG-C5) * Operational Gap Analysis v 2.0 Gap 22: Performance-Based Navigation | |
| Portfolio: | * Performance Based Navigation |

# Initial High-Performance Routes

|  |  |
| --- | --- |
| Point of Contact & Organization: | Anton Koros, ANG-C43 |
| Project Status: | New Work |

## Executive Summary

* Develop new High-Performance Routes (HPRS) based upon seasonal wind patterns
* Define airline equipage standards for HPRs and user benefits

## Executive Direction

* The Chief Scientist has requested more information about this topic

## Description

The High Altitude (HA) Trajectory-Based Applications concept will place new High-Performance Routes (HPRs) (similar to Q routes but with two lanes and thus slightly wider than standard routes) through sectors based seasonal winds. Traffic on HPRs will be given priority over other traffic when feasible. Working with partner airlines, this task will develop and validate HPRs for summer and winter jet stream configurations within the existing infrastructure. These are planned to issue to OAPM for operational consideration

In addition, this task will define the equipage standards necessary to fly HPRs. In addition to RNAV2 is RNP2 also required? What benefits would be afforded by data communications, RNP-2, ADS-B and other NextGen technologies? The result is recommended equipage standards and updated procedures to reflect those standards.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 |  |  |  |
| FY13 | * Conduct NAS modeling/route development of the basic structure for HPR network designs * Design initial static HPRs for seasonal jet stream patterns | FY14 | $600,000 |
| FY14 | * Validate HPRs via fast-time simulation | FY15 | $350,000 |
| * Evaluate HPR equipage standards via engineering analysis & initial airline benefit assessment | FY16 | $600,000 |
| FY15 | * Develop Turnover package of HPRs | FY16 | $200,000 |

## References

|  |  |
| --- | --- |
| Operational Improvement: | * 108209 - Increase Capacity and Efficiency Using Area Navigation (RNAV) and Required Navigation Performance (RNP) * 104117 – Improved Management of Arrival/ Surface/ Departure Flow Operations * 108206 – Flexible Airspace Management |
| Source: | * [Research](https://nasea.faa.gov/products/roadmap/main/display/14) Lead Interviews – Anton Koros, ANG-C43 |
| Portfolio: | * Performance Based Navigation |

# Dynamic High Performance Routes

|  |  |
| --- | --- |
| Point of Contact & Organization: | Anton Koros, ANG-C43 |
| Project Status: | New Work |

## Executive Summary

* Follow-on activity to initial High Performance Routes
* Develop tool requirements for dynamic routing of high performance routes based on jet stream, predicted turbulence and special use airspace.
* Facilitate the introduction and management of HPRs by evaluating controller workload implications

## Executive Direction

* The Chief Scientist has requested more information about this topic

## Description

This activity is follow-on work to initial High Performance Routes (HPRs). Following the successful development of HPRs to account for seasonal jet stream configurations, HPRs could be developed dynamically daily to optimize routes based upon a number of variables. This task would evaluate the tool requirements to dynamically route high performance routes based on jet stream, predicted turbulence and special use airspace. This would be done in conjunction with partner airlines and the command center. Dynamic HPRs are expected to provide user benefits in terms of fuel savings and flight time.

In addition, this task would facilitate the introduction and management of HPRs by evaluating controller workload implications. The HA HITL confirmed that controllers can effectively manage HPRs and use multiple sorting strategies, but the effect of placing new routes daily through a sector was outside the scope of that study.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY11 |  |  |  |
| FY13 |  |  |  |
| FY14 |  |  |  |
| FY15 | * Perform engineering analysis of potential variables and required inputs for dynamic HPRs * Conduct cognitive walkthrough or SME panel with industry to investigate items such as HPR impacts on the controller, process for command center establishing the daily route, etc. | FY16 | $800,000 |
| FY16 | * Develop initial requirements & prototype * Perform fast-time simulation to evaluate prototype | FY18 | $2,000,000 |
| FY17 | * Continue prototype development * Perform initial HITL/part task of HPR | FY19 | $2,000,000 |
| FY18 | * Perform HITL 2 with full stakeholders and functionality (Command Center and Controllers) * Evaluate controller workload via simulations where controllers run their home sector and then run it with the "new" HPR | FY20 | $2,000,000 |
| FY19 | * Perform field demonstration at Command Center | FY21 | $3,000,000 |
| FY20 | * Validate results and develop turnover package | FY22 | $600,000 |

## References

|  |  |
| --- | --- |
| Operational Improvement: | * 108209 - Increase Capacity and Efficiency Using Area Navigation (RNAV) and Required Navigation Performance (RNP) * 104117 – Improved Management of Arrival/ Surface/ Departure Flow Operations * 108206 – Flexible Airspace Management |
| Source: | * [Research](https://nasea.faa.gov/products/roadmap/main/display/14) Lead Interviews – Anton Koros, ANG-C43 |
| Portfolio: | * Performance-Based Navigation * Separation Management |

# Conflict Resolution Advisories (CRA)

|  |  |
| --- | --- |
| Point of Contact & Organization: | Mike Paglione, ANG-C41 |
| Project Status: | Ongoing |

## Executive Summary

* Continue to work with NextGen and ERAM program offices to develop automatic conflict resolution advisory for ERAM R7
* Continue to coordinate conflict resolution development with complimentary TBO Solution Set NextGen project, Separation Management and Modern Procedures, and its development of an R-side conflict probe capability

## Executive Direction

* The Chief Scientist has deferred funding this project to a later year

## Description

Today, aircraft separation is handled by controllers using radar displays to visualize trajectories, make operational judgments, and implement solutions through voice clearances to aircraft - practices that tend to be highly tactical, rather than strategic in nature. As traffic volume increases in the future, efficiency will decrease due to higher levels of complexity in the NAS. Conflict Detection and Resolution relies upon automation to evaluate trajectories, predict conflicts, alert controllers to potential issues, and automatically suggest resolutions. The resolution advisories can be issued by voice or later by data communications. Instead of monitoring the sector airspace display to predict potential problems and mentally calculating problem resolutions, the automation not only predicts the problems but determines the best solution.

This work builds upon Phase 1 activities funded in FY 10 and FY11 to support the ERAM release schedule. Through a series of simulations including mini-evaluations and full HITLs, the team will validate Build 1 and assess cost, benefits, requirements, risks, procedures, CHI design. The project is defined in terms of incremental builds of deployable capabilities. Build 1 capability includes the most mature set of tools and menus that support basic two stage maneuvers and an initial ranked list of automation generated resolutions. Build 2 will add more complex multiple segment maneuvers and more constraints such as time based metering. Future builds may include more complex topics such as the airspace constraints caused by convective weather.

Via close coordination, turnover products will be issued to the ERAM team for implementation per their release schedule. Products will include prototype automation and algorithms, ConOps, draft procedures, CHI design, and requirements.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY10 | Perform Automation development  Conduct safety assessment  Develop initial ConOps  Perform fast-time simulation for benefit analysis  Conduct HITL #1 | FY11 | $5,500,000 |
| FY11 | * Conduct HITL #2 * Develop initial system requirements: CHI design, procedures, process * Write preliminary validation report:   + System description summary   + Preliminary benefits assessment   + Safety/ risk assessment   + Experiment/ analysis substantiation | FY12  FY13 | $1,781,000 |
| FY13 | * Continue Analysis of HITL #2 Initial Build 1 * Conduct HITL #3 w/ Build 1 |  | $300,000  $1,200,000 |
| * Develop final Build 1 research products   + Revise ConOps and Requirements | FY15 | $1,000,000 |
| FY14 | * Develop final Build 1 research products   + Benefits assessment   + Safety/risk assessment   + Technical Transfer | FY15 | $1,000,000 |
| FY15 | Develop Build 2   * + Automation development   + Updated ConOps and Requirements   + SME Mini-Evaluations | FY17 | $3,000,000 |
| FY16 | Continue Build 2 development   * + Benefits assessment   + Safety/risk assessment   Conduct HITL #4 – Build 2 | FY18 | $2,200,000 |
| FY17 | Develop final Build 2 research products | FY19 | $800,000 |

## References

|  |  |  |
| --- | --- | --- |
| Operational Improvement: | * 102114 – Initial Conflict Resolution Advisories * 104103 – Current Conflict Probe * 104127 - Automated Support for Conflict Resolution | |
| Source: | * Research Lead Interviews – Mike Paglione, ANG-C41 * NAS EA Support Activity 166 : ATC Human Factors: Conflict Resolution Advisories | |
| Portfolio: | * Separation Management |

# Special Activities Airspace (SAA) Use and Management

|  |  |
| --- | --- |
| Point of Contact & Organization: | Marc Buntin, ANG-C43 |
| Project Status: | New Work |

## Executive Summary

* Develop a concept, requirements and high level procedures for the management and access to SAA in the effort to provide significant benefits to NAS users

## Executive Direction

* The Chief Scientist did not think OCVM needed to work on this because the research relates to the AIM Segment 2 work.

## Description

Recent discussions with several of the major Flight Operations Centers reaffirmed that having access to SAA when they are not active would constitute a huge savings in time of flight and fuel for the airlines and other NAS users. The objective of this project is to develop a viable concept that would coordinate the opening and closure of SAA throughout the NAS while providing the required communication and tools to all stakeholders. This task includes the identification of the required automation tools, communications channels and high-level procedures needed for airspace managers and users. The task includes the participation of stakeholders such as the Department of Defense, Homeland Security, the airlines and other significant NAS users affected by SAA. Fast-time, Part-task and full simulations will be performed to validate requirements, benefits and procedures.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 | Develop draft ConOps and initial requirements through focus group discussion | FY14 | $400,000 |
| FY13 | Develop final ConOps and procedures, conduct fast-time simulations, real-time simulation | FY14 | $1,500,000 |
| FY14 | Conduct real-time simulation/field demonstration | FY15 | $2,000,000 |
| FY15 | Develop final requirements, benefits analysis and high-level procedures | FY16 | $600,000 |

## References

|  |  |
| --- | --- |
| Operational Improvement: | * 108212 Improved Management of Special Activity Airspace * 108206 – Flexible Airspace Management * 108213 – Dynamic Airspace Performance Designation |
| Source: | * Research Lead Interviews – Kristina Carr & Marc Buntin (ANG-C4) * NAS EA – Support Activity 187: Automation Requirements for Flexible Airspace Management * NAS EA – Support Activity 263: Flexible Airspace Management Validation Activities |
| Portfolio: | * On-Demand NAS Information |

# PBN in a Flexible Route System

|  |  |
| --- | --- |
| Point of Contact & Organization: | Phil Bassett, ANG-C42 |
| Project Status: | New Work |

## Executive Summary

* Evaluate integration of performance based navigation in more flexible NAS of the future.
* Focus on top of descent to runway
* Follow-on and related work to IADCS, EM-HAT, High Performance Routes, Flexible Airspace Management, ongoing OAPM effort

## Executive Direction

* The Chief Scientist did not support this effort. Felt the proposal was too vague.

## Description

This research effort includes an emphasis on the implementation and integration of Performance-Based Navigation (PBN) procedures and routes in the metroplex environment. It will consider the challenges of transitioning PBN elements into the NAS, and may include specific research on ATC assigned routes, Optimized Profile Climbs, airspace modifications/redesign, and other issues that directly affect PBN implementation. PBN procedures and routes will be challenged in the future when more flexible airspace and routing becomes a reality. How can we best integrate a performance based navigation system to fit within the more flexible NAS of the future? This would impact the best equipped best served benefits. Research would focus on top of descent to the runway.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 |  |  |  |
| FY13 | * Perform functional analysis for PBN in flexible route * Develop study plan describing the integration of various NextGen concepts for PBN * Develop research plan for testing the proposed integration * Develop a shortfall analysis & initial ConOps | FY14 | $600,000 |
| FY14 | Perform cognitive walkthrough or other testing  Update ConOps & procedures  Conduct BEBS Impact analysis  Perform fast-time simulation | FY15 | $800,000 |
| FY15 | * Conduct HITL#1 | FY17 | $1,300,000 |
| FY16 | * Conduct HITL or field demonstration | FY19 | $2,000,000 |
| FY17 | * Conduct field demonstration | FY20 | $3,500,000 |
| FY18 | * Develop turnover package | FY22 | $800,000 |

## References

|  |  |
| --- | --- |
| Operational Improvement: | * 108209 - Increase Capacity and Efficiency Using Area Navigation (RNAV) and Required Navigation Performance (RNP) |
| Source: | * Research Lead Interviews - Phil Bassett |
| Portfolio | * Performance Based Navigation |

# Common Services Data Comm Level 2 ConOps

|  |  |
| --- | --- |
| Point of Contact & Organization: | Lisa Smith, ANG-C43 |
| Project Status: | New Work |

## Executive Summary

* Develop a Level 2 ConOps for Common Services Data Comm

## Executive Direction

* The Chief Scientist did not think this was needed. A concept was already written with the Europeans.

## Description

The updated Operational Gap Analysis v 2.0 indicates a need for a Level 2 Common Services Communications ConOps document. This ConOps would include the capabilities associated with Air-Ground Voice and Data Services, Air-Air Data Services, Ground-Ground Voice and Data Services, and Net-Centric Services. After developing the Level 2 ConOps, an opportunity exists to develop a Level 3 Data Comm ConOps that elaborates more on a specific operational capability which has been identified in the Level 2 ConOps. This follow-on work could continue through FY15.

## Funding and Activities

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 |  |  |  |
| FY13 | * Develop Level 2 or 4 Data Comm ConOps | FY14 | $300,000 |
| FY14 | Develop Level 4 Data Comm ConOps | FY15 | $300,000 |
| FY15 |  |  |  |

## References

|  |  |  |
| --- | --- | --- |
| Operational Improvement: | * 101102 - Provide Full Flight Plan Constraint Evaluation with Feedback * 103305 - On-Demand NAS Information * 105207 - Full Collaborative Decision Making * 105208 - Traffic Management Initiatives with Flight Specific Trajectories * 105302 - Continuous Flight Day Evaluation * 104207 Enhanced Surface Traffic Operations * 104124 Use Optimized Profile Descent | |
| Source: | * Research Lead Interviews – Lisa Smith (ANG-C4) * Operational Gap Analysis v 2.0 Gap 24: Data Comm Level 3 ConOps * NAS EA Support Activity 42: ATC/FD Data Comm Concepts ConOps | |
| Portfolio: | * Common Services |

# Datalink of Complex PBN Clearances in Support of 4D Trajectory Based Operations (TBO)

|  |  |
| --- | --- |
| Point of Contact & Organization: | Marc Buntin, ANG-C4 |
| Project Status: | New Work |

## Executive Summary

* Define candidate complex clearances for transmission via data link that support the execution of PBN procedures (arrival/departure, high altitude high -performance lanes, convective/SAA reroutes, etc.)
* Develop ConOps and perform an initial cost benefit analysis
* Starting point: Leverage work previously performed to extend 3D PAM execution in a Data Link environment and Tailored Arrivals. The Team will utilize previous related studies, subject matter experts and perform limited engineering analysis and fast-time simulation.

## Executive Direction

* FY13 Estimate of $800K was support by the Chief Scientist
* FANS-1A has already been investigated by NASA
* Study should focus on ATN-2B
* Approval for concept exploration: Developing the concept (linkage to RNAV airspace), engineering analysis, benefit story
* Make sure task begins with a Literature Review.  Do not re-study what has already been studied.

## Description

Having the ability to Data Link complex PBN Clearances (CCs) to aircraft in support of TBO has the potential of making operations in both the terminal and En Route domains more operationally and cost efficient. For example complex PBN clearances could be the means by which metering functions are performed in both the En Route and terminal environment in the support of arrival / departure 4D trajectory operations. Complex PBN clearances can be issued as transitions to STARS, alternate runways or high performance routes. Complex PBN clearances could be used to route around adverse weather, SAAs, etc., or they can be used as a means to efficiently execute traffic management initiatives. This task will build off of the results from work which was successfully performed that extended the 3D PAM concept into the Data Link environment and Tailored Arrivals. This task includes 1) Identifying what complex PBN clearances are operationally and technically viable and cost beneficial. 2) Developing the concept of operations for the use of these clearances. 3) Development of an initial Cost Benefit Analysis in support of complex PBN clearances. The focus of this work will be aimed toward the use of the ATN B2 Data Link capability. The outcome from this activity will be used to help define ATN requirements which are needed currently to support the implementation of ATN in the 2023 timeframe.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY13 | * Identify candidate CCs that are viable for the mid and far term and yield the highest benefit. CCs will be mapped to the following capabilities: * ATN B2 avionics and mix environment (FANS 1/A / ATN) * Develop initial requirements & procedures | FY14 | $800,000 |
| FY14 | * Continue requirements & procedures development via simulation | FY15 | $1,200,000 |
| * Conduct initial (ROM) benefits assessment |  |  |
| * Identify initial message set (FANS 1/A and/or ATN 2B) |  |  |
| FY15 | * Validate requirements & procedures development via high-fidelity simulation and field testing * Conduct a refined benefits assessment * Define final message set (FANS 1/A & ATN 2B) * Complete input for ATN Message Set Finalization including:   + Message sets   + Requirements   + Procedures | FY16 | $2,500,000 |

## References

|  |  |  |
| --- | --- | --- |
| Operational Improvement: | * 104117 - Improved Management of Arrival/Surface/Departure Flow Operations * 104120 - Point-in-Space Metering * 104122 - Integrated Arrival/Departure Airspace Management * 104123 - Time Based Metering Using RNAV and RNP Route Assignments * 104124 - Use Optimized Profile Descent | |
| Source: | * Research Lead Interviews – Marc Buntin (ANG-C4) * Operational Gap Analysis v 2.0 Gap 22: Performance-Based Navigation | |
| Portfolio: | * Performance Based Navigation |

# NextGen D-Taxi Services

|  |  |
| --- | --- |
| Point of Contact & Organization: | Levent Ileri, ANG-C42 |
| Project Status: | New Work |

## Executive Summary

* During discussions on October 2010 scenarios, NATCA saw additional uses for D-Taxi messaging. NATCA expected benefits for use to deliver taxi instructions while in movement area. Research would determine what messages would be used frequently and whether use of these messages in the movement area could be done without comprising safety. Ultimate product would be recommendations for messages to be included in Segment 2 D-Taxi services.
* Determine frequency of use of D-Taxi messages by the controller and test the use of non-time critical tactical D-Taxi messages on the ground side
* Conduct an integrated HITL and evaluate the HITL design
* Develop CONOPS for Segment 2 D-Taxi Services

## Executive Direction

* The Chief Scientist has deferred funding this project

## Description

This work builds upon research conducted in support of Segment 2 Data Comm efforts from 2007 to 2010. Current surface movement operations require extensive collaboration and coordination between a controller and a pilot. New large metro airports have created the need for lengthy and complex

taxi instructions. Data communications (data link/D-taxi) services are added to the NAS to reduce frequency congestion, aircrew workload, controller workload, enhance safety and reduce confusion. Leveraging the Data Communications for Taxi capability, this research enables the generation of complex taxi clearances (e.g., to dynamically re-sequence aircraft, to avoid other traffic, and/or to include runway crossing restrictions in the clearance). Uses of D-taxi clearances simplify this effort by providing taxi-instructions via data communications.

The research will determine frequency of use of D-Taxi messages by the controller and test the use of non-time critical tactical D-Taxi messages on the ground side. In addition, the research will conduct an integrated HITL. If time and funding permit, exploratory study to evaluate and validate the feasibility of a BEBS policy for use will be researched. The final product will be to develop a CONOPS for Segment 2 D-Taxi services, provide recommendations for messages to be included in Segment 2 D-Taxi services, and technical transfer the research to the operational service unit. This project will improve surface management efficiency, safety, and accuracy of flights meeting controlled departure times through the integration of Data Communications for taxi clearances and Integrated Display for Departure Route and Time Management.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY08 | * HITL Planning | FY11 |  |
| FY13 | * Develop ConOps for Segment 2 D-Taxi Services | FY13 | $100,000 |
| * Conduct Cognitive walkthrough with ATC SMEs to define D-Taxi messages on the ground and associated benefits, and report documenting the  cognitive walkthrough results | FY14 | $450,000 |
| FY14 | * Conduct D-Taxi HITL with ATC SMEs/pilots | FY14 | $1,200,000 |
| * Develop Preliminary Requirements document * Develop Technical transfer Package for the Operational Service Unit | FY15  FY16 | $650,000 |
| FY15 |  |  |  |

## References

|  |  |
| --- | --- |
| Operational Improvements: | 104117 – Improved Management of Arrival/Surface/Departure Flow Operations  104122 – Integrated Arrival/Departure Airspace Management  104123 – Time Based Metering Using RNAV and RNP Route Assignments |
| NextGen Portfolios: | Improved Surface Operations   * + 104208-22 – Enhanced Departure Management With Taxi Clearance Data Communication   Collaborative Air Traffic Management  Time-Based Flow Management |
| Source: | Research Lead Interviews - Levent Ileri (ANG-C42) |
| Portfolio | Improved Surface Operations |

# Remote Operations at Non-Towered Airports (RONA)

|  |  |
| --- | --- |
| Point of Contact & Organization: | Kristina Carr, ANG-C41 |
| Project Status: | Ongoing |

## Executive Summary

* Define and validate a concept to provide remote operations at non-towered airports
* Related work includes the Staffed NextGen Tower concept and the collaborative efforts between the State of Colorado and the Surveillance and Broadcast Services (SBS) Program Office to increase access to Colorado ski airports.

## Executive Direction

* Estimated FY13 Funding - **$0**
* OCVM is to fund concept development and validation only. If FY12 funding is not enough to support this effort we may be able to justify FY13 funds.
* OCVM funding will not be used for prototype development. SBS will need to pay for any prototype development

## Description

Current IFR operations at some non-towered airports are inefficient for both the FAA and stakeholders. Instrument operations at non-towered airports can require extensive ATC coordination between the Center and the local TRACON (if one exists). If there is no surveillance coverage, this compounds the problem. If there are multiple IFR flights arriving at a non-towered airport with little to no surveillance, only one aircraft can land at a time. The following aircraft cannot be cleared to land until air traffic receives confirmation by phone or other means that the landing aircraft arrived and is cleared the active runway. Following aircraft must remain in holding until they receive a clearance to land from air traffic control. This is called a “one-in-one-out” operation. This operation can significantly reduce throughput and cause operators to accrue excessive flight time/miles which consumes more fuel, increases harmful emissions.

Current efforts are underway to provide surveillance at several non-towered airports through the use of wide-area multilateration and ADS-B. Additionally, there are several low-cost technologies that are under development to surveillance at these airports. Improved surveillance along with modified ATC procedures will improve operations at these airports. ANG-C4 has partnered with the SBS office to develop an operational concept and procedures for remote towered operations at currently non-towered airports. Activities through FY15 could include safety analysis around surveillance requirements, and a field demonstration.

## Funding and Activities

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 | Concept Exploration including Shortfall Analysis & ConOps  Task Analysis with SME  Fast-time simulation Modeling  Part Task HITL | FY13  FY14 | $2,400,000 |
| FY13 | Prototype Development  HITL #1 | FY15-Q1 | $2,400,000 |
| * FY14 | * Field Demonstration * Begin technical transfer package | FY16 | $2,000,000 |
| FY15 | Complete technical transfer package | FY17 | $800,000 |

## References

|  |  |  |
| --- | --- | --- |
| Operational Improvement: | * 109402 – Remotely Staffed Tower Services * 102138 – Expanded Radar-like Services to Secondary Airports | |
| Source: | * Research Lead Interviews – Kristina Carr (ANG-C4) * Surveillance Broadcast Services Program Office & State of Colorado | |
| Portfolio: | * Improved Surface Operations |

# Advanced Applications of Automatic Dependent Surveillance-Broadcast (ADS-B) In

|  |  |
| --- | --- |
| Point of Contact & Organization: | Marc Buntin, ANG-C4 |
| Project Status: | New Work |

## Executive Summary

* Develop ADS-B In applications which will provide significant benefits to the user community (including airlines, Part 135 and Part 91 operators)

## Executive Direction

* The Chief Scientist explained that this work will be funded by the ADS-B in FY15

## Description

As part of the NextGen and other global activities such as SESAR, ADS-B will replace radar as the primary surveillance method for controlling aircraft worldwide. ADS-B has many benefits associated with its use including the ability to transmit not only aircraft position but a whole plethora of information including aircraft type, state data, trajectory intent, weather, etc. ADS-B can vastly improve and expand the capability of ground automation tools and through the use of a cockpit display of traffic information (CDTI) situational awareness data can be provided to the flight crew as well as a means for flight crews to perform operations that will significantly enhance efficiency of flight and safety.

This focus of this project is to identify portfolios of ADS-B applications that will provide significant benefits to NAS operators and the FAA. The portfolio that is identified as the most viable (highest priority/low-hanging fruit) will actually start in development. A portfolio implies multiple ADS-B In applications that are associated with a given level of avionics equipage. Portfolios are necessary to insure that users can achieve maximum benefit and minimal cost of avionics. This project will leverage work that has been previously performed by Surveillance and Broadcast Services Office, Safe Flight 21, NASA and other organizations. There are at least twenty one ADS-B In applications that were identified by the FAA and members of SESAR that are potentially viable applications. Most of these applications are immature in terms of development and have not been packaged as portfolios. This tasks in involves working directly with SBS Office, AVS, the airlines, air framers and avionics manufacturers.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 |  |  |  |
| FY13 | * Literature review and meetings with the SBS Office, AVS, NASA, airlines, industry and other research organizations to identify beneficial and viable ADS-B In applications based on previous work * Report revealing the beneficial portfolios ADS-B In applications in priority rank | FY14 | $600,000 |
| * Start development of the initial portfolio of ADS-B In application |  |  |
| FY14 | Develop Initial ADS-B In Portfolio   * + Requirements definition   + High level procedures development   + simulations (part, full and fast-time) * Update MASPS/ MOPS * Perform Initial Benefits Analysis | FY15 | $2,500,000 |
| FY15 | * Develop, test, & validate initial ADS-B In Portfolio:   + Simulations   + Field tests (flight deck/ ATC) | FY16 | $2,000,000 |
| FY16 | * Update documentation: requirements, procedures, benefits * Update MASPS and MOPS | FY17 | $700,000 |

## References

|  |  |  |
| --- | --- | --- |
| Operational Improvement: | * 102123 – ADS-B Separation * 103208 – Improved Runway Safety Situational Awareness for Pilots * 103208 – Improved Runway Safety Situational Awareness for Pilots * 102406 – Provide Full Surface Situation Information * 104207 – Enhanced Surface Traffic Operation | |
| Source: | * Research Lead Interviews – Marc Buntin (ANG-C4) * NAS Enterprise Architecture – Support activity 296: SBS Aircraft-to-Aircraft Horizontal Separation CDTI Assisted Visual System * NAS Enterprise Architecture – Support activity 304: Surface Collision Avoidance * NAS Enterprise Architecture – Support activity 441: Surface Conflict Detection and Resolution (CD&R) | |
| Portfolio: | * Improved Surface Operations |

# Integrated Collaborative Air Traffic Management (CATM) ConOps

|  |  |
| --- | --- |
| Point of Contact & Organization: | TBD |
| Project Status: | New Work |

## Executive Summary

* Develop an integrating and overarching CATM ConOps including an implementation plan and prioritization of to-go CATM work

## Executive Direction

* The Chief Scientist believes that this was done in by Rich Jehlen 2 years ago

## Description

While numerous lower level ConOps exist for Collaborative Air Traffic Management (CATM), no single Level 2 ConOps describes an overall view for CATM. This document would specify roles and responsibilities for both air and ground, lay out an implementation plan, and prioritize individual CATM efforts and OIs. Specific topics in the ConOps may include a description of how to achieve single-source access and identify the “standard” services and subscriptions.

## Funding and Activities

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 |  |  |  |
| FY13 | * Develop Level 2 CATM ConOps | FY14 | $300,000 |
| FY14 |  |  |  |
| FY15 |  |  |  |

## References

|  |  |  |
| --- | --- | --- |
| Operational Improvement: | * 105207 – Full Collaborative Decision Making * 101102 – Provide Full Flight Plan Constraint Evaluation with Feedback * 103305 – On-Demand NAS Information * 105302 – Continuous Flight Day Evaluation | |
| Source: | * Operational Gap Analysis v2.0 Gap 1: CATM ConOps * Operational Gap Analysis v2.0 Gap 2: Single Source Access/Data Consolidation | |
| Portfolio: | * Collaborative Air Traffic Management |

# Enhanced Departure Predictability for TFM (EDPT)

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| --- | --- |
| Point of Contact & Organization: | Kevin Hatton, ANG-C4 |
| Project Status: | Ongoing |

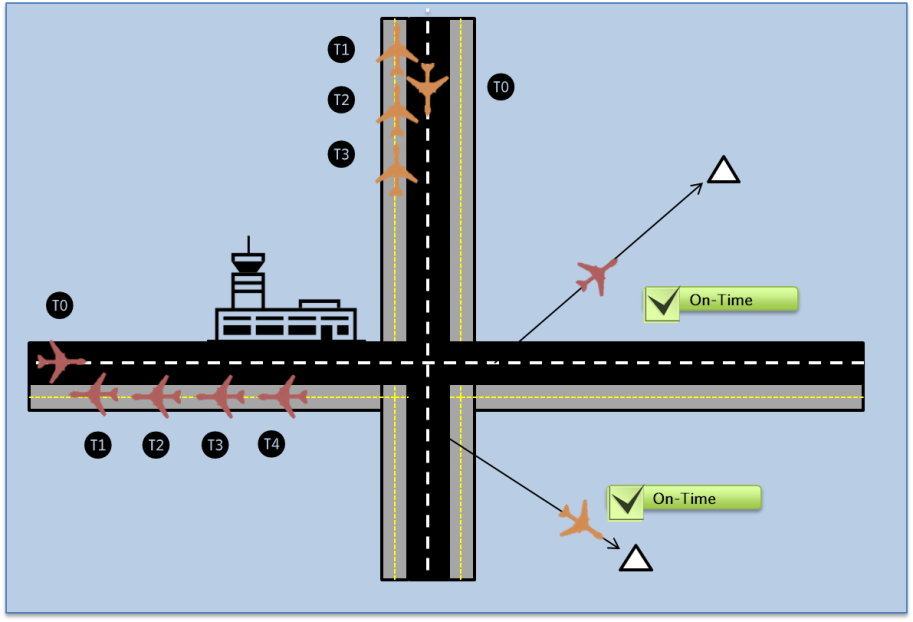
## Executive Summary

* This research will analyze the amount of improvement in off-time predictions from enhanced NAS user tools, the ability to provide such improved data to TFM, and the resulting improvements in demand predictions
* EDPT proposes to demonstrate the ability and benefits of better off-time predictions through collaboration with airlines and industry to conduct an operational demonstration of such a tool

## Executive Direction

* The Chief Scientist would fund any demonstration out of the C5 demo line.

## Description

 Reliable off-time predictions will improve the quality of demand estimates across the NAS and allow Traffic Management Initiatives (TMIs) that are implemented due to demand to be more efficient. Initial EDPT research utilized fast-time simulation to model departure prediction improvements and estimate benefits. Additional analysis is currently being conducted to identify the categories of operations (operator type, origin airport capabilities, etc.) that offer the greatest potential benefits.

Future EDPT research evaluates the potential departure time prediction improvements that may be possible utilizing operator provided data in deterministic tools. For look-ahead times of 30, 45, 60 minutes and beyond, the operator is the best source of accurate data. Utilizing a deterministic approach, significant improvements may be possible by utilizing operator-provided data such as real-time status of airframe, crew, passengers, baggage, etc. However, airlines currently do not utilize tools that allow the real-time integration of all operational data to provide high-quality departure time predictions. EDPT proposes to demonstrate the ability and benefits of better off-time predictions through collaboration with airlines and industry to conduct an operational demonstration of such a tool. The goal is to measure the amount of improvement in off-time predictions, the ability to provide such improved data to TFM, and the resulting improvements in demand predictions.

## Activities & Funding

| FY$ | Research Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY11 | * Explore the FBTM concept via Research Plan and fast-time simulation | FY12 | $300,000 |
| FY12 | * Conduct fast-time simulation to test improved departure predictions benefits | FY14 | $440,000 |
| FY13 | * Demonstrate deterministic departure predictability tool at field site ( 2 year demonstration) | FY16 | $1,750,000 |
| FY14 | * Investigate approach to utilizing and differentiating departure predictions from multiple sources. | FY15 | $325,000 |
| * Develop BEBS schema for EDPT | FY15 | $400,000 |
| FY15 | * Perform engineering analysis to integrate EDPT into NAS | FY16 | $350,000 |

## References

|  |  |  |
| --- | --- | --- |
| Operational Improvement: | * 105104 - NAS Wide Sector Demand Prediction and Resource Planning * 104208 – Enhanced Departure Flow Operations * 104117 – Improved Management of Arrival/Surface/Departure Flow Operations * 105207 – Full Collaborative Decision Making * 104206 – Full Surface Traffic Management with Conformance Monitoring * 104209 – Initial Surface Traffic Management | |
| Source: | * Research Lead Interviews – Kevin Hatton | |
| Portfolio: | * Time-Based Flow Management |

# Statistical Methods for Departure Predictability (SMDP)

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| --- | --- |
| Point of Contact & Organization: | Kevin Hatton, ANG-C4 |
| Project Status: | New Work |

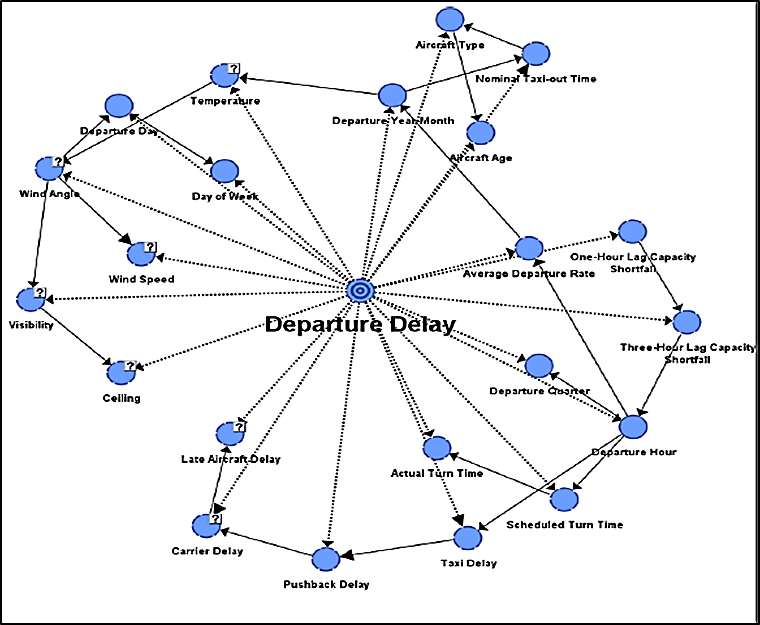
## Executive Summary

* SMDP research will develop a probabilistic directed acyclic graphical model for improving departure time predictions by developing a Bayesian Belief Network (BBN) model that will utilize numerous historic data that will improve the reliability of departure time predictions for real-time traffic flow management

## Executive Direction

* The Chief Scientist has approved full FY13 funding of $700k for this proposal

## Description

Dependable departure time predictions will improve the quality of demand estimates across the NAS and allow trajectory based operations to operate more accurately and efficiently. Initial SMDP research will focus on the data required to facilitate departure time predictions using probabilistic statistical tools.

Furthermore, SMDP research will identify the feasibility of providing live data feeds from critical NAS data sources as well as operator-provided data. SMDP proposes to demonstrate the improvements that may be possible by utilizing advanced statistical tools for departure time predictions in pursuing accurate trajectory based operations.

SMDP research will explore a probabilistic method for improving departure time predictions by developing a Bayesian Belief Network (BBN) model that will utilize historic data for numerous data points that might affect the reliability of departure time predictions. Data nodes for a given flight could include day of week, time of day, departure and arrival airport, type aircraft, passenger load, etc. The BBN could provide a prediction of departure time based upon any number of data points, with the quality of the prediction increasing as more data is available.

## Activities & Funding

 = Approved

| FY$ | Research Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY13 | * Provide framework for data mining from external sources including airlines for ingestion by NAS resources to improve systemic forecasts | FY14 | $250,000 |
| * Develop Probabilistic Departure Predictability Tool (Bayesian Belief Network (BBN)) | FY14 | $450,000 |
| FY14 | * Refine BBN to accept initial operational data in laboratory setting | FY15 | $600,000 |
| FY15 | * Update BBN to incorporate real-time operational data | FY16 | $400,000 |
| FY16 | * Develop requirements for BBN as active trajectory tool | FY17 | $400,000 |
| * Develop technical transfer package for implementation with TFMS:   + Requirements   + Procedures | FY18 | $200,000 |

## References

|  |  |
| --- | --- |
| Operational Improvement: | 105207 - Full Collaborative Decision Making (Far Term – Parts are Mid Term)  104117 - Improved Management of Arrival/Surface/Departure Flow Operations  104206 - Full Surface Traffic Management with Conformance Monitoring  104208 - Enhanced Departure Flow Operations |
| Source: | Research Lead Interviews – Kevin Hatton (ANG-C42) |
| Portfolio: | Time-Based Flow Management |

# TMI Attribute Standardization (TAS)

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| --- | --- |
| Point of Contact & Organization: | Kevin Hatton, ANG-C4 |
| Project Status: | New Work |

## Executive Summary

* This research will utilize historical and present TMI data to define a system model in which TMI attributes are categorized in a manner that will facilitate real-time TMI information and feedback to NAS users, unified TMI modeling, post-event analysis, and continuous flight day evaluation
* This research will also result in standardized TMI entry, parsing, and tracking, by enhancing functionality currently provided by NTML

## Executive Direction

* The Chief Scientist has approved full FY13 funding of $700k for this topic

## Description

Performance analysis, where throughput is constrained, is the basis for strategic operations planning.  Continuous (real-time) constraints are necessary for Air Navigation Service Provider (ANSP) traffic management decision-support tools and National Airspace System (NAS) users.  Evaluation of NAS performance requires both a real-time activity feedback tool and a post-event analysis process. The National Traffic Management Log (NTML) provides a holistic view of TMI’s in NAS. Presently, TMIs are disseminated, tracked, and recorded through a non-standardized approach resulting in an inability to efficiently parse TMI data. Inability to efficiently parse NTML/TMI data results in a lack of a unified view of TMIs in the NAS along with an inability to model TMIs during demand or impact analyses.

This research will utilize historical and present TMI data to define a system model in which TMI attributes are categorized in a manner that will facilitate unified TMI modeling, real-time TMI information and feedback to NAS users, post-event analysis, continuous flight day evaluation, and standardized TMI input and output.

Real-time and post-event TMI analysis will allow the ANSP and NAS users to utilize more efficient and informed trajectories. In addition, standardized TMI input and output will streamline NAS performance constraint response and assessment. Furthermore, this standardization will improve the efficiency and understanding of multiple TMIs in the NAS.

 = Approved

## Activities & Funding

| FY$ | Research Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY13 | * Categorize TMI Attributes and Values | FY14 | $700,000 |
| FY14 | * Develop TMI System Model * Develop Low-Fidelity Prototype | FY15 | $600,000  $50,000 |
| FY15 | * Develop High-Fidelity Prototype | FY16 | $900,000 |
| * Conduct simulation of prototype for validation | FY17 | $800,000 |
| FY16 | * Conduct field demonstration of prototype | FY18 | $1,500,000 |
| FY17 | * Develop technical transfer package to Sys Ops/En Route: prototype, requirements, draft procedures, ConOps | FY19 | $500,000 |

## References

|  |  |
| --- | --- |
| Operational Improvement: | 105207 - Full Collaborative Decision Making (Far Term – Parts are Mid Term)  104117 - Improved Management of Arrival/Surface/Departure Flow Operations  104206 - Full Surface Traffic Management with Conformance Monitoring  104208 - Enhanced Departure Flow Operations  105302 - Continuous Flight Day Evaluation |
| Source: |  |
| Portfolio: | Collaborative Air Traffic Management |

# ERAM Controller Information Tool (ECIT)

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| --- | --- |
| Point of Contact & Organization: | Anton Koros, ANG-C43 |
| Project Status: | Ongoing |

## Executive Summary

* Develop a simplified ERAM toolbar which concisely and efficiently displays the most pertinent information for a controller
* Toolbar will be designed within *existing* ERAM functionality and additional capabilities, if any, will be identified as gaps for future development

## Executive Direction

* Chief Scientist supports this work. He is OK with breaking the information requirements between ERIDs, D, and R, and supports this work if that is what the ATO would prefer.
* Apparently, OMB likes the generic concept approach.
* Not sure if we need to go to Mitre first or directly to Lockheed. Coordinate with En Route and see if it makes sense to go directly to Lockheed.
* Anton Koros coordinating with AJV and AJE. ~$1M remains on FY12 PLA and any additional funding will be needed from FY13.

## Description

ERAM provides increased information to controllers, which could potentially make it more difficult to locate required data efficiently as information may be several layers deep in a menu structure. In addition, NextGen enables more flexibility requiring controllers to memorize many more airspace configurations, radio frequencies, routes, etc.

The objective of this task is to develop an ERAM toolbar that provides controllers with immediate and efficient access to the most commonly used information, or information that changes frequently. ANG-C4 sponsored HITL simulations (NASA) and information requirements analyses (CAASD) which identified the critical information to be included on the menu. Field participants in Generic Airspace simulations indicated that efficiently providing this information would assist controllers. In addition, supervisors suggested that this tool would support them as they maintain currency. The tool would also benefit controllers as they accommodate more frequent airspace reconfigurations and other factors such as increased radio frequencies. This task would assess information requirements against current ERAM capabilities, identify those that can be made available *today* with existing ERAM functionality, and identify those for which ERAM modifications would be needed. The proposed research involves building upon the existing work funded with FY12 $ to develop an initial software design and evaluate that design. The end product would be a turnover package to the ERAM team for implementation.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 | * Perform ERAM Controller Information Toolbar Assessment * Perform ERAM Functionality/ECIT Gap Analysis | FY14-Q1 | $920,000 |
| FY13 | * Design initial ECIT software for existing ERAM functionality * Evaluate ECIT software design via focus group or cognitive walkthrough | FY15 | $2,000,000 |
| FY14 | * Validate ECIT design via simulation or field testing | FY16 | $2,500,000 |
| FY15 | * Develop technical transfer package to ERAM Framework: requirements, preliminary computer-human interface design, and cost/benefit analysis * Coordinate and integrate with receiving ERAM team | FY17 | $500,000 |

**References**

|  |  |
| --- | --- |
| Operational Improvement: | * 103305 – On-Demand NAS Information * 102137-25 R- and D- Position Information Sharing |
| Source: | * Research Lead Interviews - Anton Koros, ANG-C43 * NARP (2012) Goal: Improve computer-human interface design to reduce information overload and resulting errors. |
| Portfolio | * Common Services |

# Unmanned Aircraft Systems (UAS) Integration in the NAS

|  |  |
| --- | --- |
| Point of Contact & Organization: | Sherri Magyarits, ANG-C43 |
| Project Status: | Ongoing |

## Executive Summary

* Decompose Concept of Operations for UAS Integration into the NAS, Version 2.0, to identify operational requirements, develop lower level (III and IV) operational concepts, and conduct shortfall analysis

## Executive Direction

* Estimated FY13 Funding - **$0**
* Only supports OCVM funding if a real gap is uncovered.
* Chief Scientist does not support using this line for lower level ConUse documents, because he feels that UAS operations should already be covered in the ConUse documents for NVS, Data Comm, and ACAS. If there are gaps here, the specific programs should fund them.
* If a higher level gap not covered by a lower-level ConUse is uncovered, then we can come back with request for FY13 Funding.

## Description

The FAA is in the process of safely accelerating UAS integration into the NAS, based on Congressional direction set forth for 2015. FY12 funding will support functional analysis to identify operational requirements and continued operational scenario development. Shortfall Analysis development has been moved from FY12 to FY13 activities to better sequence concept development. FY13+ activities are focused on continued concept exploration via SME panels. ANG-C4 will also support the development of lower-level UAS concepts as required based on the analyses. Operational requirements will be developed and refined throughout the analysis. ANG-C4 will update the UAS ConOps Version 2.0 as required based on feedback from both the internal and external stakeholder communities.

## Activities & Funding

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 | * Conduct UAS functional analysis/develop operational requirements * Continue operational scenario development | FY13-Q4 | $575,000 |
| FY13 | * Develop 2 Lower Level (Level 3 and 4) Operational Concepts | FY14 | $500,000 |
| * Conduct Shortfall Analysis and continue requirements definition | FY15 | $500,000 |
| FY14 | * Update UAS ConOps V 2.0 via Subject Matter Expert (SME) Panel | FY15 | $300,000 |
| FY15 |  |  |  |

## References

|  |  |  |
| --- | --- | --- |
| Operational Improvement: |  | |
| Source: | * Operational Gap Analysis v 2.0 * Research Lead Interviews - Sherri Magyarits (ANG-C43) * Research Lead Interviews - Sabrina Saunders-Hodge (ANG-C2) * NAS Enterprise Architecture – Support Activity 523: Unmanned Aircraft Systems Research * JPDO’s NextGen Unmanned Aircraft Systems Research, Development and Demonstration Roadmap Version 1.0 | |
| Portfolio: | * N/A |

# Space Vehicle Operations (SVO)

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| --- | --- |
| Point of Contact & Organization: | Kevin Hatton, ANG-C4 |
| Project Status: | Ongoing |

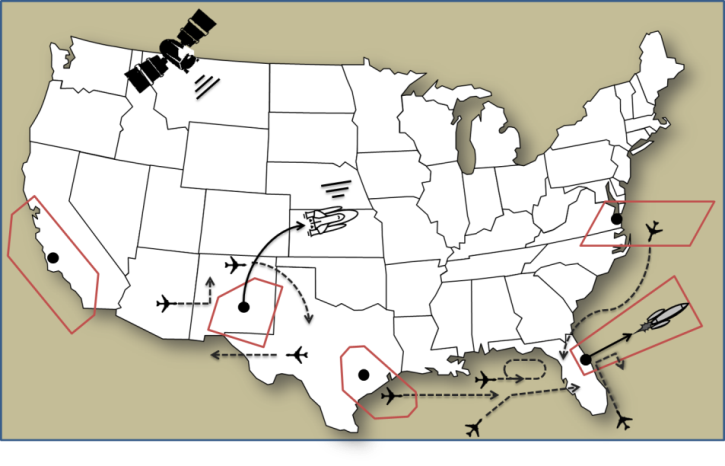
## Executive Summary

* This research will analyze space vehicle operations to include launch patterns, trajectory characteristics, safety data, locations, expected launch quantities, and impact to airborne and ground aircraft
* This research will result in a SVO Concept of Operations, covering pre-launch, launch, recovery, and a NAS/Safety impact assessment

## Executive Direction

* The Chief Scientist only supports judicious use of funds for this for further exploration of possible shortfall. And only for currently controlled airspace (control of SVO above FL600 is not our job).
* Therefore, following activities will be pursued.
  + Concept of Operations development is approved at $**450K**
  + Impact analysis, integrated simulation capability, and debris threat activities are approved at $1**00K**

## Description

As part of Flow-Based Trajectory Management (FBTM), there is a need to understand the implications of introducing and accommodating space vehicles into current and future trajectory operations. Secretary LaHood formed the Center of Excellence for Commercial Space Transportation (COE CST) in 2010 in order to facilitate the development of solutions to existing and anticipated commercial space transportation problems. Space Traffic Management (STM) and operations has been identified by the COE CST as a focus area for research. This research area includes Space Traffic Management (STM) and operations of vehicles from the ground, through suborbital flight, to orbit. More specifically this includes pre-launch planning, the integration of air and space traffic, and spaceport operations. Space vehicles often have various launch patterns, locations, and frequencies, contributing to inefficient methods of airspace management. There is a need to more efficiently process space vehicle launch requests in a manner that assesses and mitigates NAS impacts. Processing these launch requests requires greater understanding of space vehicle trajectories and manipulation of special activity areas optimizing NAS performance. This research area requires analysis of space vehicle operations to include launch patterns, trajectory characteristics, safety data, locations, expected launch quantities, and impact to airborne and ground aircraft.

**Activities & Funding**

| **FY$** | **Research Activity** | **Finish Date** | **Funding** |
| --- | --- | --- | --- |
| FY12 | * Perform Space Vehicle Operations shortfall analysis | FY13 | $300,000 |
| FY13 | * Perform impact analysis of conducting a SVO on NAS | FY14 | $200,000 |
| * Evaluate available NAS Simulation platforms for SVO | FY13 | $100,000 |
| * Develop integrated NAS/Space Simulation Capability | FY14 | $200,000 |
| * Perform SVO cognitive walkthrough | FY14 | $275,000 |
| * Develop SVO functional requirements | FY14 | $325,000 |
| * Develop SVO preliminary ConOps | FY14 | $250,000 |
| * Enhance COE CST’s SVO Debris Threat Model | FY15 | $150,000 |
| FY14 | * Develop trajectory algorithms for nominal & off-nominal scenarios for incorporation into NAS tools | FY15 | $500,000 |
| * Integrate SVO into NTN activities and research | FY15 | $60,000 |
| * Perform SVO HITL #1 | FY16 | $1,450,000 |
| FY15 | * Perform SVO HITL #2 | FY17 | $950,000 |
| * Update SVO Concept of Operations | FY17 | $85,000 |
| * Develop Technical Transfer Package: prototype, requirements, draft procedures, and ConOps | FY18 | $800,000 |

## References

|  |  |  |
| --- | --- | --- |
| Operational Improvement: | 108212 - Improved Management of Special Activity Airspace  103305 - On-Demand NAS Information  104124 - Use Optimized Profile Descent  105208 - Traffic Management Initiatives with Flight Specific Trajectories  106202 - Enhance Emergency Alerting | |
| Source: | Research Lead Interviews – Kevin Hatton (ANG-C42)  2012 National Aviation Research Plan: “Identify the requirements for safe commercial space transportation operations”  Center of Excellence for Commercial Space Transportation | |
| Portfolio: | Collaborative Air Traffic Management |

# Mixed Equipage Research for Operational Concepts Validation

|  |  |
| --- | --- |
| Point of Contact & Organization: | TBD |
| Project Status: | New Work |

## Executive Summary

* Map avionics requirements for mid-term concepts against current and planned fleet equipage, to determine benefits

## Executive Direction

* The Chief Scientist explained this work should be done by Ron Stroup in ANG-D

## Description

As the NAS transitions to NextGen, research efforts must address the future effects of mixed equipage and multiple levels of service due to differing levels of aircraft capability. This effort involves performing an analysis of the operational concepts that are planned for NextGen implementation and determining the equipage needed. ANG-C4 will leverage work previously performed by the Air/Ground Integration Team in the development of the avionics roadmap. ANG-C4 will map the avionics requirements for mid-term NextGen concepts against current and planned fleet equipage. This will assist in determining which mid-term avionics configurations offer significant benefits. Costs and benefits will be established around these configurations.

A possible next phase of this task could be to look at the ground automation requirements, including decision support tools, necessary to support the concepts. The cost and benefits will be revisited after completing this analysis.

## Funding and Activities

| FY$ | Activity | Finish Date | Funding |
| --- | --- | --- | --- |
| FY12 |  |  |  |
| FY13 | * Develop avionics equipage configurations to support the mid-term | FY14 | $800,000 |
| FY14 | * Assess costs and benefits of avionics configurations for aircraft | FY15 | $500,000 |
| FY15 |  |  |  |

## References

|  |  |  |
| --- | --- | --- |
| Operational Improvement: | * 102137 - Automation Support for Separation Management | |
| Source: | * REDAC NAS Operations Subcommittee – Finding 4 * RTCA Task Force 5 Recommendations – Incentivizing Equipage | |
| Portfolio: | * Policy |