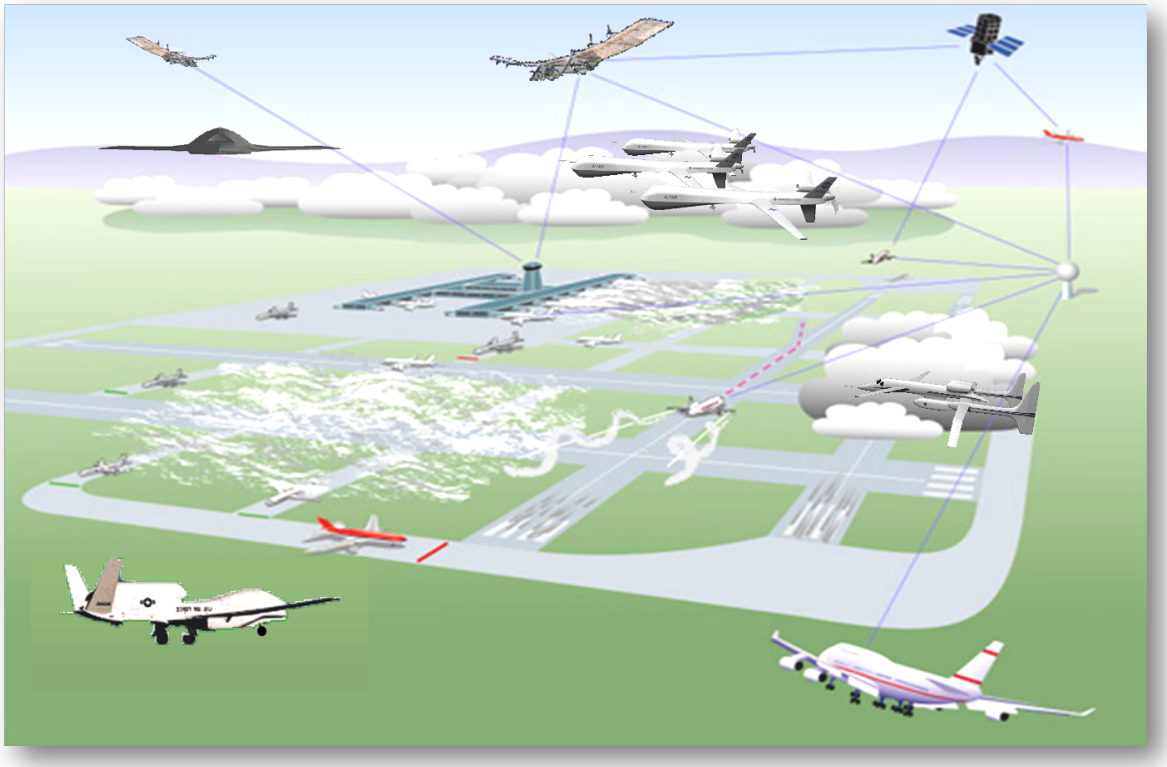
UAS Integration in the NAS Project

Project Overview



Presented by: Mr. Chuck Johnson
Project Manager, UAS Integration in the NAS

NASA Advisory Council - Aeronautics Committee
Dryden Flight Research Center
April 14, 2011

Project History

- Planning/Advocacy within Agency and Administration from January, 2009 to February, 2010
- FY11 President's Budget released February, 2010
  - New Project established at $30M per year
- Briefing by Ms. Marion Blakey to the NASA Advisory Committee on April 28, 2010
- NRC Meeting of Experts accomplished on August 5, 2010
- Formulation Review accomplished October 21, 2010
- Acquisition Strategy Panel/Acquisition Strategy Meeting accomplished October 22, 2010
- Delta Formulation Review accomplished on December 16, 2010
- Project start delayed during Continuing Resolution

UAS NAS Access Activities Underway During CR

These efforts will provide immediate Benefits to the UAS Community

- American Recovery and Reinvestment Act (ARRA) tasks
- Roadmap work
- NASA Research Announcements (NRAs)
- Small Business Innovative Research (SBIR) Subtopics

ARRA Tasks

ARRA funds provided by ARMD ($6.00M) and SMD ($0.75M) are being leveraged to provide immediate benefits to the Project and JPDO

Tasks:

- UAS State of the Art in today's NAS
- Consolidated ConOps
- NextGen UAS ConOps
- Gap Analysis, Consolidated ConOps against today's NAS
- Modeling and Simulation Infrastructure and tools development
- Communication and Avionics infrastructure Improvements

Roadmap Work

- **JPDO**
  - Working with JPDO to develop a research, development and demonstration (RD&D) roadmap for UAS access to the NAS due to OMB by the end of FY11. The RD&D roadmap will provide the foundation for a technology roadmap necessary for the overall National Roadmap for UAS access into the NAS and NextGen.

- **FAA**
  - Working with FAA and key stakeholders to define success and to ensure that a National Roadmap is created which includes (at a minimum) policy, procedures, and technology. These areas of concentration need to be integrated to show all activities required for UAS to be safely integrated into the NAS and NextGen.

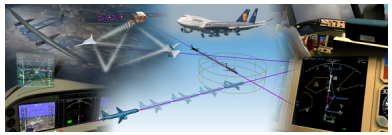
NRA Tasks and SBIR Subtopics

- **NRA UAS solicitation supplements project objectives**
  - **ARMD (Two step solicitation)**
    - Favorable community response
    - 25 Mar Invitations to Step 2 were issued for selected Step 1 proposals
    - Awards 4th qtr FY11
  - **SMD (One step solicitation)**
    - ROSES Process

- **One SBIR Subtopic for UAS Integration in the NAS**
  - Technology areas addressed
    - UAS Model Construction from Realtime Surveillance Data
    - Distributed System for Rapid Collection of Human-in-the-Loop Simulation Data
    - Certified control and non-payload communications (CNPC) system
    - System for Rapid or Automated UAS Flight Planning

Developing/Continuing Collaboration and Partnerships


Integrated Systems Research Program



Airspace Systems Program


Aviation Safety Program


Fundamental Aeronautics Program

UAS Integration in the NAS Project

Academia

Industry

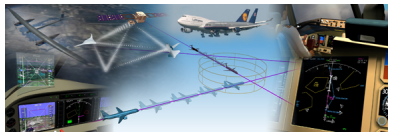


Other Government Organizations

International

Developing/Continuing Collaboration and Partnerships


Integrated Systems Research Program



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Integrated Systems Research Program

- UAS Project Formulation Direction
- Coordinating with JPDO, FAA, & ExCom

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Other Government Organizations

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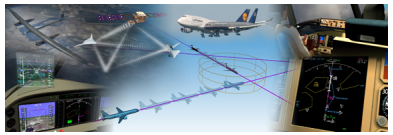

Airspace Systems Program


Aviation Safety Program


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Airspace Systems Program

- Concepts and Technology Development Project
- Separation Assurance

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Industry



Other Government Organizations

International

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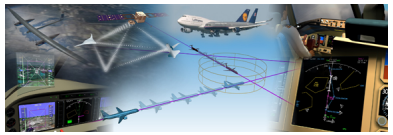

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- Developing collaborations with applicable projects and research

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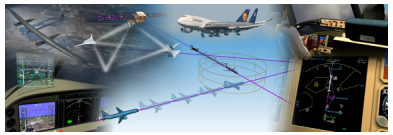

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<u>Fundamental Aeronautics Program</u>

- Developing collaborations with applicable projects and research

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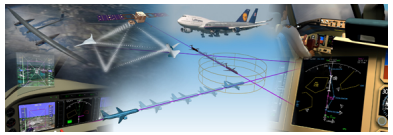

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Academia

- Developing engagement s through robust NRA investment

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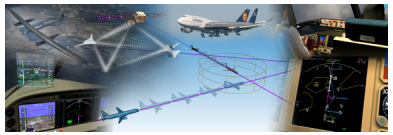

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Industry

- Developing engagement through NRAs and SBIR
- Seeking wider consortium-like industry teaming

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Developing/Continuing Collaboration and Partnerships


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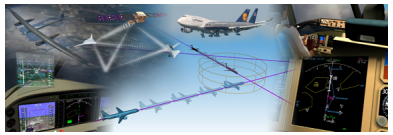

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Other Government Agencies (including FFRDCs)

FAA – AVS (UAPO), ATO (ATO-P including FAATC)
JPDO
DoD (including AFRL)
DHS
VOLPE
MITRE

NAS

Academia

Industry

Other Government Organizations

International

Developing/Continuing Collaboration and Partnerships


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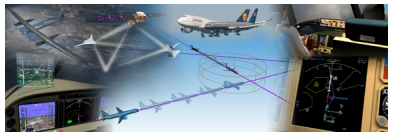

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International

- Developing international relationships
  - ICAO, EUROCAE, NATO
  - ONERA, DLR
  - UVSI
  - Australian Research Centre for Aerospace Automation

NAS Project

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Other Government Organizations

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Developing/Continuing Collaboration and Partnerships


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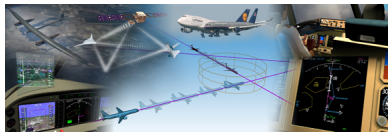

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Other Government Organizations

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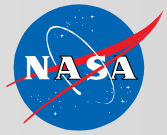
Project Activities If Execution is Delayed Until FY12



Core team (about 15 individuals) will continue to:

- Complete the ARRA tasks
- Work with the JPDO and associated government agencies tasked by OMB to complete and deliver an R&D Roadmap for UAS NAS access by the end of FY11
- Work with the FAA, other government agencies, and industry to develop a National Roadmap for UAS access including policy, procedures, and technology.
- Continue to expand on partnerships both domestically and internationally including other government agencies, industry, standards committees, NATO, DLR, ONERA, EUROCAE, and others
- Award NRAs and SBIRs which will enhance our Project deliverables and provide significant benefits to the UAS community

UAS Integration in the NAS

Vision

- A global transportation system which allows routine access for all classes of Unmanned Aircraft Systems

Mission

- Utilize integrated system level tests in a relevant environment to reduce technical barriers related to the safety and operational challenges of Unmanned Aircraft Systems (UAS) National Airspace System (NAS)
- Work with key stakeholders to define necessary deliverables/products to help enable UAS access to the NAS

Technology Development Areas

- Separation Assurance, Human Systems Integration, Communications, Certification, Integrated T&E

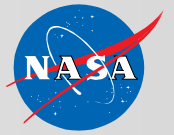
Key Stakeholders

- UAS ExCom, FAA, JPDO, Standards and Regulatory Organizations

Separation Assurance	Human Systems Integration	Communication	Certification
Assess the applicability to UAS and the performance of NASA NextGen separation assurance concepts in flight tests with realistic latencies and trajectory uncertainty	Develop a research test-bed and database to provide data and proof of concept for GCS operations in the NAS	Develop data and rationale to obtain UAS frequency spectrum allocations	Define a UAS classification scheme and approach to determining airworthiness requirements (FAR xx.1309) applicable to all UAS digital avionics
Assess how NextGen separation assurance systems with different functional allocations perform for UAS in mixed operations with manned aircraft	Coordinate with standards organizations to develop human factors guidelines for GCS operation in the NAS	Develop and validate UAS secure safety critical C2 test equipment Perform analysis to support recommendations for integration of safety critical C2 systems and ATC communication	Provide recommendations for hazard and risk-related data collection to support development of type design criteria and standards
Integrated Test and Evaluation Human-in-the-loop Simulations and Flight Test Series			

Time-frame for Impact 2015 to 2025

Separation Assurance



- **Goals**
  - Demonstrate NextGen algorithm effectiveness for UAS operations
  - Determine the efficacy of different separation assurance functional allocation paradigms for UAS in NextGen

- **Objectives**
  - Assess the applicability to UAS and the performance of NASA NextGen separation assurance concepts in flight tests with realistic latencies and trajectory uncertainty
  - Assess how NextGen separation assurance systems with different functional allocations perform for UAS in mixed operations with manned aircraft

Separation Assurance

- **Technical Challenge**
  - **Safely and seamlessly integrate UAS into NextGen separation assurance**
    - Cruise speeds, turn rates, climb/descent performance different from manned aircraft
    - Different missions than manned aircraft
    - Communication and control latency
    - Transitions of control between humans and automation
    - Procedural compatibility with air traffic control system

Human Systems Integration

- **Goal**
  - Develop the database, by instantiating proof of concept GCS, to work with standards organizations on recommended guidelines for GCS integration in the NAS

- **Objectives**
  - Develop a research test-bed and database to provide data and proof of concept for GCS operations in the NAS
  - Coordinate with standards organizations to develop human factors guidelines for GCS operation in the NAS

Human Systems Integration

- **Technical Challenges**
  - **Database and Proof of Concept**:
    - Display airspace information without increasing workload
      - Address UAS characteristics that make them different from manned aircraft
        - » Limited in-situ sensory input
      - Assess human-automation interaction and responsibility between onboard automation and the aircraft operator
  - **Human Factors Guidelines**:
    - Develop standard against which to assess UAS ground control stations
      - Current UAS GCS interfaces are aircraft specific, non-standard
      - Lack of standardized airspace information displays

Communications

- **Goal**
  - Validate secure scalable robust datalinks within allocated frequency spectrum for UAS

- **Objectives**
  - Develop data and rationale to obtain appropriate frequency spectrum allocations to enable the safe and efficient operation of UAS in the NAS
  - Develop and validate candidate UAS secure safety critical command & control (C2) system/subsystem test equipment which complies with UAS international/national frequency regulations, ICAO Standards and Recommended Practices, and FAA/RTCA Minimum Operational Performance Standards/Minimum Aviation System Performance Standards for UAS
  - Perform analysis to support recommendations for integration of safety critical C2 system and ATC communications to ensure safe and efficient operation of UAS in the NAS

Communications

- **Technical Challenge**
  - **Validate new UAS spectrum and data link communications to enable UAS integration in the NAS**
    - Currently, UAS are managed through exceptions and are operating using DoD frequencies, amateur bands, or unlicensed Instrument/ Scientific/Medical frequencies. None of these frequency bands are designated for safety and regularity of flight
    - UAS require new frequency spectrum allocations and a new data communications system which is both secure and scalable

Certification

- **Goal**
  - Recommend airworthiness requirements and type design criteria for UAS to facilitate safe operation in the NAS

- **Objectives**
  - Define a UAS classification scheme and approach to determining airworthiness requirements (FAR xx.1309) applicable to all UAS digital avionics
  - Provide recommendations for hazard and risk-related data collection to support development of type design criteria and standards

Certification

- **Technical Challenges**
  - **Airworthiness**
    - The current aircraft classification scheme and corresponding airworthiness requirements are not directly applicable to the full range UAS
  - **Hazard and Risk-Related Data**
    - Little UAS specific data (incident, accident, and reliability) exists in a civil context to support development of standards and regulations.

Integrated Test & Evaluation

- **Goal**
  - Integrate and test concepts, technologies, and capabilities in relevant environments that can enable UAS access to the NAS

- **Objectives**
  - Integrate and test mature concepts from the technical elements to demonstrate and test viability
  - Evaluate the performance of the research in a relevant environment (full mission human-in-the-loop simulations and flight tests)

Integrated Test & Evaluation

- **Technical Challenges**
  - **Creation of an appropriate test environment**
  - **Integration of the technical research to probe and evaluate the concepts**
  - **Coordination and prioritization of facility and aircraft schedules**

Summary

The goal of the UAS Integration in the NAS Project is to contribute capabilities that reduce technical barriers related to the safety and operational challenges associated with enabling routine UAS access to the NAS

- **Leveraging Current NASA Investments**
  - UAS NAS Access Activities Underway will provide immediate benefits to the UAS community
- **Partnership Plan**
  - NASA has engaged key stakeholders in the planning of this project and will continue to do so to leverage assets of OGA's, industry and academia to execute plan
- **Technical Plan**
  - Technical elements have been vetted with stakeholders and are complementary efforts
  - Project will employ a two-phased approach in which validation of key technical elements will be assessed in Phase 1; Phase 2 will focus on maturing and testing technical foci in relevant environments