UAS Integration in the NAS Project and Future Autonomy Research

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Developing the UAS-NAS Project

There is an increasing need to fly UAS in the NAS to perform missions of vital importance to National Security and Defense, Emergency Management, and Science. There is also an emerging need to enable commercial applications such as cargo transport (e.g. FedEx).

Provide research findings to reduce technical barriers associated with integrating Unmanned Aircraft Systems into the National Airspace System utilizing integrated system level tests in a relevant environment.
The NASA UAS-NAS Project is influenced by several key stakeholders within the UAS Community which helped guide its formulation.
FAA Pathway to UAS Access

- The FAA is using several domestic forums, in conjunction with several international forums to lay out the pathway for their priorities and investments.
  - If work is conducted outside of the pathway, the FAA may be unwilling to collaborate

**Joint Planning & Development Office (JPDO):** Forum where collaboration for NextGen research occurs across gov’t agencies and industry

**World Radio Conference and International Civil Aviation Organization (ICAO) UAS Study Group** are addressing UAS access from an international perspective

**RTCA SC-228**

**FAA Pathway**

**UAS Executive Committee (ExCom):** Senior gov’t steering group focused on streamlining public UAS access

**UAS Aviation Rulemaking Committee (ARC):** Developed civil UAS Implementation Plan based on the FAA’s UAS CONOPs & Roadmap

**OSD SAA Science and Research Panel (SARP):** Chartered by OSD to identify SAA Research Gaps

**NASA has a leadership role within each of these forums**
UAS-NAS Project OV-1

Legend:
- NAS Elements
- Enabling Capability
- DAA Technologies
- Air Traffic Services
- CNPC Network
- Legacy C2 Links

- Cooperative Aircraft
- Non-cooperative Aircraft
- Air Traffic Services (Enroute)
- sUAS Operational Procedures
- Commercial UAS Operations
- Detect and Avoid
- Radar and Detection Capabilities
- Enroute Air Traffic Services
- UAS Control Station
- Human Systems Integration
- Research Control Station
- UAS Restricted Use Certification
- T-34 UAS Surrogate CNPC Test Aircraft
- CNPC Ground Stations
- SATCOM Uplink
- CNPC Network
- CNPC Test Aircraft
- CNPC Ground Stations
- Precision Agriculture
- UAS-NAS Project OV-1
UAS-NAS Technical Challenges

**SAA Performance Standards**
- Provide research findings to develop and validate UAS Minimum Operational Performance Standards (MOPS) for sense and avoid (SAA) performance and interoperability.

**C2 Performance Standards**
- Provide research findings to develop and validate UAS Minimum Operational Performance Standards (MOPS) for terrestrial command and control (C2) communication.

**Human Systems Integration**
- Provide research findings to develop and validate human systems integration (HSI) ground control station (GCS) guidelines enabling implementation of the SAA and C2 performance standards.

**Integrated Test and Evaluation**
- Develop a relevant test environment for use in generating research findings to develop and validate HSI Guidelines, SAA and C2 MOPS with test scenarios supporting integration of UAS into the NAS.
NASA’S Vision for Civil Aviation

Where does autonomy fit?

Transforming Aviation
Autonomy enabling a new overall aviation system with vastly greater capabilities such as on-demand transportation

Enabling New Capabilities
Autonomy enabling re-designed or completely new components of the system to improve safety, efficiency and mobility

Infusing Functionality
Autonomy infused into targeted components of the current system for improvements to safety and efficiency, and to expand the constraints and boundaries of the system

GLOBAL
Safety, NextGen
Efficiency, Environment

SUSTAINABLE
Intelligent
Low Carbon

TRANSFORMATIVE
On Demand
Fast
Autonomy

Autonomy is implemented in harmony with humans to maximize the benefit of aviation to society

Human

Adaptable

Informative

Self-optimization

Self-healing

Collaborative

Interactive

Self-protection

Self-configuration

Informative

Adaptable
Autonomy Strategy Framework

Vision

Autonomy is implemented in harmony with humans to maximize the benefit of aviation to society

Needs

Technologies & Applications
Develop archetypal / model autonomy standards, technologies, functions and mission applications to broadly enable innovation

Architectures, Methods & Metrics
Develop architectures and meta-design tools that enable the efficient and effective creation of joint human-machine cognitive systems

Trusted Systems Integration
Address the challenges associated with trust between humans and autonomous systems

Real World Testbeds
Establish relevant testbeds for testing autonomous systems

Challenges

Technical (Research to Enable)
Issues such as human-machine collaboration, TEV&V, machine reasoning, sensor integration, etc.

Socio-Policy (Research to Inform)
Issues such as liability, public acceptance, moral decision-making, transformation of human roles/tasks, etc.