UAS Integration in the NAS Project and Future Autonomy Research

Mr. Chuck Johnson
Senior Advisor for Unmanned and Autonomous Systems

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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).

Project Focus:
Unencumbered NAS Access for Civil / Commercial UAS

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.
UAS-NAS Project Formulation
Key Stakeholders and Influencing Factors

Project Focus:
Unencumbered NAS Access for Civil / Commercial UAS

Groups Working on the Problem

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.
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)
Detect and Avoid
Enroute Air Traffic Services
Research Control Station
sUAS Operational Procedures
Commercial UAS Operations
UAS Control Station
Ikhana UAS SAA Test Aircraft
Human Systems Integration
Command and Control
T-34 UAS Surrogate CNPC Test Aircraft
CNPC Ground Stations
CNPC Network
UAS Restricted Use Certification
Precision Agriculture
Satellite Communications
Beyond Line of Sight Link
Satellite Communications
Beyond Line of Sight Link
Beyond Line of Sight Link
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 is implemented in harmony with humans to maximize the benefit of aviation to society.

Human

- Self-protection
- Self-optimization
- Self-protection
- Self-healing
- Collaborative
- Adaptable
- Informative
- Interactive
- Self-healing

Autonomy
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 toEnable)**
  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.