



## Unmanned Aircraft Systems Integration in the National Airspace System



The TigerShark flew over Edwards Air Force Base on July 9, 2019 for a systems checkout flight.  
Credis: NASA /James Ross

NASA's Unmanned Aircraft Systems Integration in the National Airspace System, or UAS-NAS project, works to identify, develop and test the technologies and procedures that will make it possible for unmanned aircraft systems (UAS) to have routine access to airspace occupied by human-piloted aircraft.

NASA researchers have worked with the UAS community since 2011 to address the technical barriers to routine UAS operations. Four NASA centers support the UAS-NAS project: NASA's Ames Research Center and Armstrong Flight Research Center both in California, Langley Research Center in Virginia and Glenn Research Center in Ohio. The UAS-NAS project is within the Integrated Aviation Systems Program, managed by NASA's Aeronautics Research Mission Directorate at NASA Headquarters in Washington, D.C.

UAS-NAS is a vital mission that provides research findings through simulations and flight tests to support the development and

validation of Detect and Avoid (DAA) and Command and Control (C2) technologies necessary for integrating UAS into the NAS.

### **UAS Detect and Avoid Operational Concepts and Technologies**

NASA works with the Federal Aviation Administration (FAA) and industry to develop DAA operational concepts and technologies in support of standards to enable a broad range of UAS to have Communication, Navigation, and Surveillance (CNS) capabilities. The effort is aimed at making UAS operations consistent with FAA's Instrument Flight Rules (IFR) that are required to detect and avoid manned and unmanned air traffic.

Ames, Armstrong, and Langley are developing NASA capabilities in: Modeling and Simulation; Guidance and Control, Human Systems Integration; and Integrated Test and Evaluation, which uses simulations and flight test.

## UAS Command and Control Operational Concepts and Technologies

The UAS-NAS team develops terrestrial-based C2 operational concepts and technologies in support of standards to enable the broad range of UAS that have CNS capabilities consistent with IFR operations and are required to leverage allocated protected spectrum. The C2 operational concepts and technologies are supported at Glenn and focused on NASA's communications capabilities.

Data results from the project's work also inform the minimum operational performance standards that the FAA is using for development of technical standards and operational approval guidance for UAS.

### UAS-NAS Milestone

In June 2018, a collaboration among Armstrong, General Atomics Aeronautical Systems, Inc. (GA-ASI), Honeywell and the FAA led to the first remotely-piloted aircraft, Ikhana, to fly in the national airspace without a safety chase plane. The Ikhana became the first aircraft to obtain a No Chase Certificate of Waiver Authorization (COA) from the FAA. The aircraft successfully flew a six-hour mission through multiple classes of civilian airspace. The Ikhana used its own DAA systems integrated onboard the aircraft and its ground control station to maintain safe separation from other aircraft. The teamwork among the various partner organizations made the demonstration a decisive success, and accomplished a major step toward the integration of UAS into the NAS.

Due to this historic achievement, Aviation Week & Space Technology selected Ikhana's No Chase COA flight as a winner of its 62nd Annual Laureate Awards, in the category of Commercial Aviation, Unmanned Systems.

### Current Research Activities

#### UAS-NAS Flight Test 6 Research

The next UAS-NAS project flight test series, Flight Test 6 (FT6), starts in the summer of 2019 to support development of DAA standards for medium-sized UAS. The objectives of these flights from Armstrong will include data collection to inform the development of minimum operational performance standards (MOPS) for DAA alerting guidance, and for small, lightweight and low



General Atomics-ASI will use the MQ-9B SkyGuardian for its SIO Demonstration Activities. (General Atomics Aeronautical Systems, Inc.)

power radar. FT6 will use the Tiger Shark, a Navmar Applied Sciences Corporation (NASC) aircraft. FT6 will require the TigerShark UAS to perform unmitigated and mitigated scripted DAA encounters with manned intruders, and with simulated traffic via the Live Virtual Constructive (LVC) environment.

The TigerShark, a Class 3 UAS, has a 22-foot wingspan and weighs about 500 pounds compared to the approximately 8,000-pound and 66-foot wingspan of the Class 5 Ikhana UAS. These flight tests will evaluate how DAA standards developed for larger, faster UAS will need to be adapted for smaller and slower aircraft and thus expand NAS access to a larger group of UAS.

### Systems Integration and Operationalization (SIO) Demonstration Activities

NASA initiated the SIO Demonstration Activity as a partnership between NASA and industry partners with the goal of accelerating routine UAS operations into the NAS. SIO will show robust UAS operations into the NAS by leveraging integrated DAA, C2, and state-of-the-art vehicle technologies with a pathway toward certification to inform FAA UAS integration policies and operational procedures.

NASA is partnering with three companies, Bell in Texas, General Atomics-ASI, in California, and PAE ISR LLC in Virginia to perform SIO demonstration activities in 2020 occurring at altitudes greater than 500 feet above ground level. The industry partners will lead the development, integration, testing, and certification of their UAS. NASA will support by providing consultation.

National Aeronautics and Space Administration

**Armstrong Flight Research Center**

P.O. Box 273

Edwards, California 93523

[www.nasa.gov](http://www.nasa.gov)

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