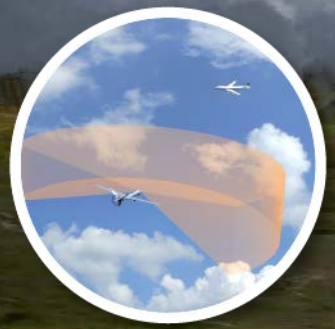

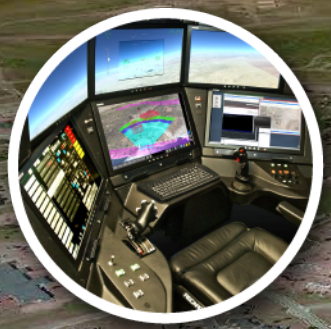

UAS Missions with Low Cost, Size, Weight, and Power (C-SWaP) Sensors

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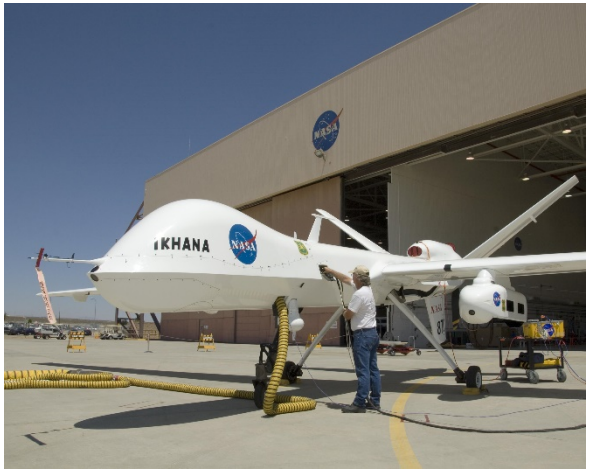
Background

- The Unmanned Aircraft Systems (UAS) Integration in the National Airspace System (NAS) project aims to reduce technical barriers related to safety and operational challenges associated with enabling UAS access to the NAS.

- NASA researchers contributed significantly to the Minimum Operational Performance Standard (MOPS) for Detect-and-Avoid (DAA) systems
  - Phase 1 RTCA work concluded in 2016
  - TSO-C211 (DAA) and TSO-C212 (airborne radar for DAA) published in 2017



NASA Ihkana

Gap in Phase 1 Work

- Phase 1 radar requires a ~8 nmi detection range
  - Only sensor for detecting non-cooperative aircraft (aircraft without transponders)
  - Power consumption likely > 1000 Watts
  - Weight likely > 60 lbs
  - Size
- For many UAS missions, a Phase 1 radar is either physically infeasible or economically impractical
- To enable additional UAS missions
  - Alternative requirements for sensors with low cost, size, weight, and/or power (C-SWaP) are currently being developed
  - DAA requirements and operational environment likely to be modified from Phase 1

Operational Assumptions

Inherited from Phase 1

- UAS are operating under IFR
- Beyond Visual Line of Sight (BVLOS)
- UAS are equipped with ADS-B out, active surveillance, and sensors for non-cooperative aircraft

Low C-SWaP sensor relevant

- UAS operations in Airspace classes D, E, and G, excluding the terminal area
  - Terminal area operations are likely enabled by ground-based surveillance
- Altitude range: between 500 ft AGL and 10,000 ft MSL
- UAS speed << 200 kts

Low C-SWaP Sensor Partnership

- The DAA Subproject sought a partner to a cooperative agreement to
  - develop requirements for airborne low cost, size, weight, and power (C-SWaP) surveillance systems
  - verify the interoperability between these new requirements and existing DAA alerting and guidance requirements
  - verify expected pilot performance can be achieved in human-in-the-loop simulations
  - validate/demonstrate the new technology during flight tests
- Request for Information in 2016, followed by Cooperative Agreement Notice
- Honeywell International was selected as partner
  - Honeywell provides low C-SWaP radar and aircraft integration support
  - NASA conducts flight tests to demonstrate integration of technology and inform the MOPS development

NASA's SIERRA-B

Related Work

- DAA Well Clear definition
- Alerting and guidance requirements with fast time simulations
- Pilot performance with human-in-the-loop simulations
- End-to-end simulations with sensor models
- EO/IR requirements (at RTCA)