Joint Detect and Avoid Flight Testing

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UAS-NAS Test Flow

Timeline Not To Scale

Integrated Human in the Loop Sim
- Preliminary MOPS Development
- MOPS Verification & Validation
- Preliminary MOPS Inputs: Aug 2014
- Preliminary MOPS Inputs: Jan 2015
- Preliminary MOPS Inputs: July 2015
- Final MOPS Inputs: Oct 2015
- Final MOPS Inputs: July 2016
- Final MOPS Inputs: Aug 2016

ACAS-XU / Self Separation
- Critical Design Reviews
- Airworthiness & Flt Safety Review
- Tech Brief
- Ikhana Mods
- Flts

Flight Test-3
- Comp’t Testing
- Integration / V&V
- System Testing
- Ikhana Mods
- Flts
- Tech Brief

FT-3 Scripted Encounters Research Goals:
- Validate results previously collected during project simulations with live data
- Evaluate TCAS II/SS interoperability
- Inform final DAA MOPS
- Reduce risk for FT-4

Flight Test-4
- Comp’t Testing
- Integration / V&V
- Rqmts Review
- Design Review
- Tech Brief
FT3 Integration Roles & Responsibilities Summary

**Honeywell**
- Provide surveillance tracking software for DAA system
- Provide instrumented TCAS II equipped intruder aircraft

**NASA**

**NASA Partner**

**NASA – AFRC (UAS-NAS / IT&E)**
- Provide Research Ground Control Station (RGCS) Infrastructure
- Provide Live Virtual Constructive (LVC) Env. Infrastructure
- Provide Intruder Aircraft (T-34/King Air)
- Provide ownship aircraft (Ikhana)
- Test Conductor Station

**NASA – ARC (UAS-NAS / HSI)**
- Provide Vigilant Spirit Control Station (from AFRL) and display definition

**NASA – ARC (UAS-NAS / SSI)**
- Provide JADEM (Autoresolver) DAA
- Provide Uncertainty model
- Devise Encounter matrix

**NASA - LaRC (UAS-NAS / SSI)**
- Provide DAIDALUS (Stratway+) DAA
- Devise Encounter matrix

**GA-ASI**
- Provide proof of concept DAA system (Engineering Development Model (EDM) Due Regard Radar (DRR), Sense and Avoid Processor (SAAP), etc.)
- Conflict Prediction Display System (CPDS) Display and IO Server

**NASA – ARC (UAS-NAS / IT&E)**
- Provide HLA infrastructure
- Provide Pseudo pilot & Controller workstations (MACS)
- Develop traffic scenarios
Flight Test 3 Scripted Encounters Requirements

• **Live Ownship (OS)**
  – Low Speed OS – DRR, ADS-B, and TCAS Sensors, Sensor Fusion

  • **Ikhana**
    – EDM DRR (±110° az and ±15° elev) non-coop sensor
    – ADS-B coop sensor
    – TCAS II v7.1 coop sensor
    – HON STM (sensor fusion/tracker)

• **Live Intruder(s)**
  – ADS-B equipped
  – TCAS II Instrumentation for interoperability test
  – High speed (250 KGS capable)
  – Multiple – 2

Work Area:
EAFB R-2515 and Buckhorn MOA
Four Corners, Mercury Spin

Honeywell King Air, N3GC
T-34, NASA 865
F-18, NASA 850
Flight Test 3 Encounters Summary

- Flight Test Series 3 (June 17 – July 24, 2015)
  - Ikhana vs. manned intruder(s)
  - 11 flights completed
    - Over 200 air to air encounters
    - DAA maneuver guidance and alerting logic checks
    - Auto TCAS II maneuvers
    - EDM radar performance near scan volume limits
    - EDM radar low altitude performance tests
    - Higher closure rate encounters with FA-18
    - Stressing multi-intruder encounters
NASA and the FAA UAS Test Sites have entered into an Indefinite Delivery Indefinite Quantity (IDIQ) contract to perform relevant UAS Testing.

NASA will leverage the contract to bring industry and the Test Sites together to partner on technology development specific to NASA’s technical goals.

2 Tasks have been awarded, each to all 6 Test Sites:
- Task 1 UTM Integration: Test Sites to integrate build 1 of UTM and fly 4 aircraft simultaneously
- Task 2 Prototype LVC-DE Connection: Test Sites to Leverage LVC-DE ICD and demonstrate prototype connection leveraging a P2 MOPS capability