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Joint Detect and Avoid Flight Testing



Heather Maliska – Deputy Project Manager for Armstrong Flight Research Center

Ramon Estrada – Due Regard Radar Program Manager, Mission Systems, General Atomics Aeronautical Systems Inc.

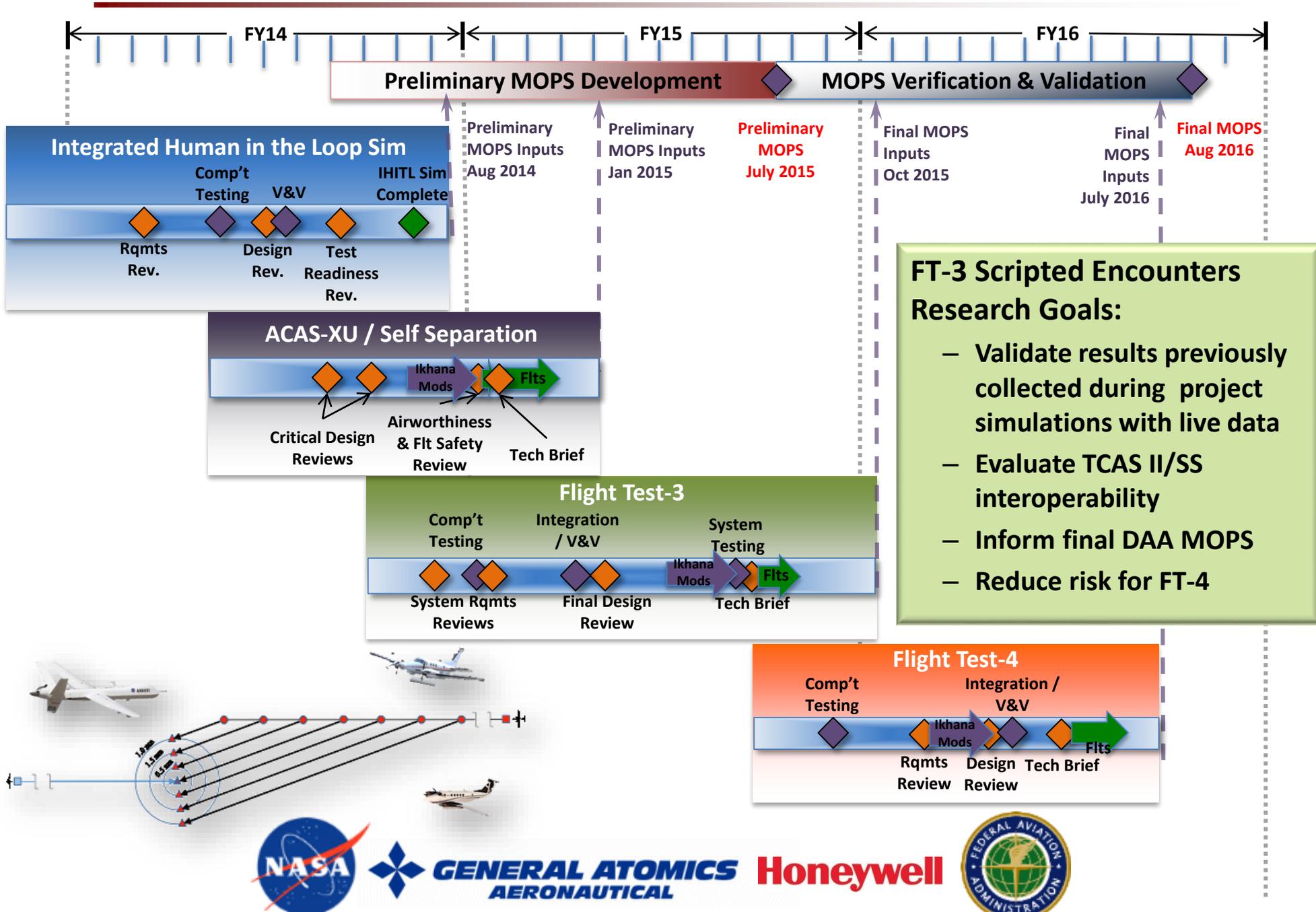
Eric Euteneuer – Need Title

Chester Gong – Need Title

Keith Arthur - Separation Assurance/Sense and Avoid Interoperability Co-Project Engineer

Timeline Not To Scale

UAS-NAS Test Flow



FT3 Integration Roles & Responsibilities Summary

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 / IT&E)

- Provide HLA infrastructure
- Provide Pseudo pilot & Controller workstations (MACS)
- Develop traffic scenarios

NASA

NASA Partner

NASA - ARC (UAS-NAS / HSI)

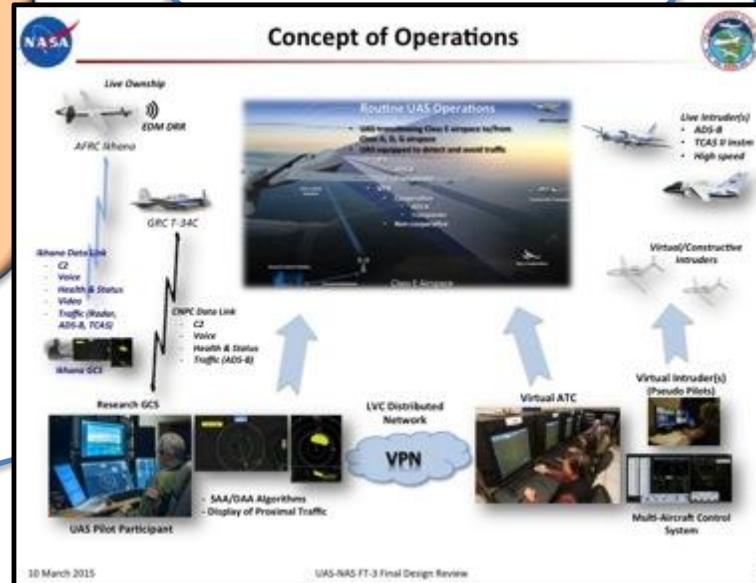
- Provide Vigilant Spirit Control Station (from AFRL) and display definition

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



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

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



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Flight Test 3 Scripted Encounters Requirements

- Live Ownship (OS)

- Low Speed OS – DRR, ADS-B, and TCAS Sensors, Sensor Fusion

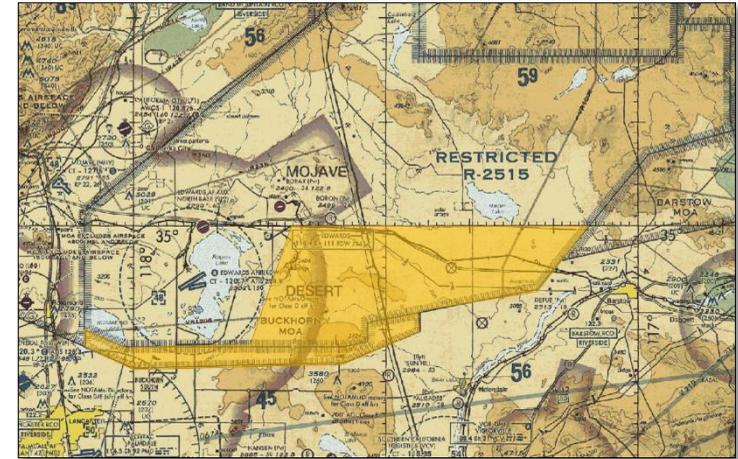
- Ikhana

- EDM DRR ($\pm 110^\circ$ az and $\pm 15^\circ$ 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



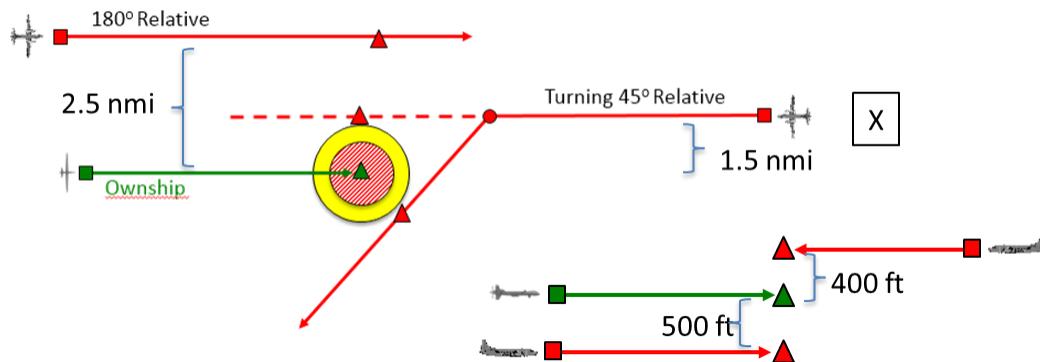
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Flight Test 3 Encounters Summary

- 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



Configuration & Nomenclature

[Series] [MinAltitudeOffset] [VerticalProfile] [EncounterAngle]

- Series
 - L LowSpeed
 - H HighSpeed
 - M Multiship
- MinimumAltitudeOffset
 - 1 1000ft
 - 2 200ft/700ft
 - 3 300ft
 - 4 400ft
 - 5 500ft
 - 6 300ft/700ft
 - 7 400ft/500ft
 - 8 2500ft
 - 9 4000ft
- VerticalProfile (Ownship/Intruder)
 - 1 H-Level/Level
 - 2 H-Level/H-Level
 - 3 H-Level/Climb
 - 4 H-Level/Descent
 - 5 Climb/Level
 - 6 Descent/Level
 - 7 Climb/Descent
 - 8 Descent/Climb
 - 9 Level/H-Level/L-Level
- EncounterAngle
 - A 0degrees
 - B 20degrees
 - C 35degrees
 - D 90degrees
 - E 10degrees
 - F 35degrees
 - G 60degrees
 - H 80degrees
 - J 45degrees
 - K 90degrees
 - L 135degrees
 - M Turning 5degrees
 - N Turning 0degrees
 - P Zig-Zag
 - Q 0
 - R 5
 - S 0
 - T 35
 - U 0/20
 - V 5/0
 - W 0/35
 - X Turning 5degrees/180degrees



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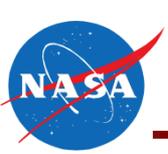
QUESTIONS???



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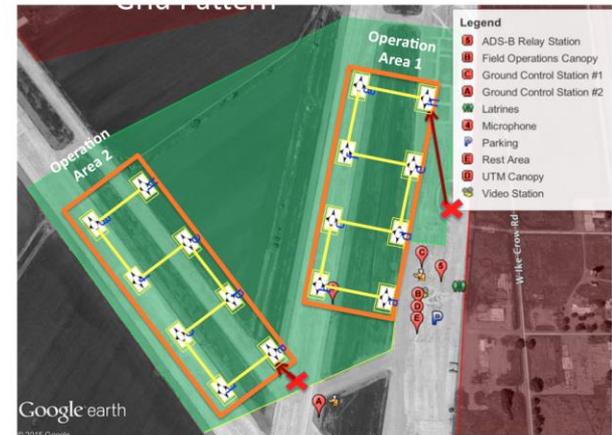


FAA UAS Test Site Contracts

- 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



TASK 1: NASA UTM Integration and Build 1 Demos



Task 2: UAS-NAS LVC-DE Build including FAA UAS Test Sites

