National Aeronautics and Space Administration

IHITL TEST READINESS REVIEW (TRR)

- **Jim Murphy**
- **Mike Brignola**
- **Conrad Rorie**
- **Confesor Santiago**
- **Mike Guminsky**
- **Ken Cross**

Meeting Information

- Location
  - AFRC, ISF
- Date and Time
  - Friday, May 30, 2014
  - 8:00 – 12:00 PDT
- Dial In Information
  - Number: 888-719-9352
  - Passcode: 4153130
- WebEx
  - Meeting Number: 995 071 733
  - Meeting Password: UASNAS2014!
  - https://nasa.webex.com/nasa/j.php?MTID=m291859e9efd510ee3be6eed0add1f4c7

IHITL Test Readiness Review Agenda

- 8:00 Introduction (Murphy/Kim) -- 15 minutes
  - Objectives and Scope of this Review
  - Timeline (this is a high level schedule)
- 8:15 Entrance/Exit Criteria (Brignola) -- 5 minutes
- 8:20 FDR Summary (Brignola) – 10 minutes
  - RFIs
  - CCRs closed
- 8:30 Overview & Objectives (Murphy) – 90 minutes
  - Summary of test goals and high level general objectives -- 15 minutes
  - HSI Review (Shively) – 45 minutes
  - SSI Ames Peer Experiment Review Summary (Santiago) – 15 minutes
  - SSI Langley Peer Experiment Review Summary (Guminsky) – 15 minutes
- 10:00 Break – 15 minutes
- 10:15 LVC-DE Status (Murphy/Kim) – 30 minutes
  - Test Setup1
  - Summary of V&V and Characterization Test Results
  - Test Setup 2
  - Summary of V&V and Characterization Test Results
  - Test Setup 3 (Langley brief)
  - Summary of V&V and Characterization Test Results
  - Includes a Langley chart (Murphy to provide a template) generated by Maria

IHITL Test Readiness Review Agenda

- 10:45 Simulation Planning and Control Room Operations (Murphy) – 30 minutes
  - Test Plan (Data Analysis Plan)
  - Test Summary
  - Daily schedule
  - Seating plans
  - Test Coordination
  - Readiness status
  - Langley staffing
  - Armstrong staffing
- 11:15 Safety Assessment (Ken Cross) – 5 minutes
  - Hazard Review
- 11:20 Public Affairs – 5 minutes
  - Ames (Tran)
  - Armstrong (Maliska)
  - Langley (Schultz)
- 11:25 Summary of Exit Criteria (Brignola) – 5 minutes
- 11:30 Roll Call

Purpose of This Review

- Out of NPR 7123: A Test Readiness Review (TRR) ensures that the test article (hardware/software), test facility, support personnel, and test procedures are ready for testing and data acquisition, reduction, and control
- The purpose of the this review is:
  a) To assess the readiness of the UAS NAS Technical team to perform the upcoming IHITL Simulation
  b) To assess whether the anticipated risks associated with conducting the tests are acceptable to the Project

Scope

- The scope of this review covers content and conduct of the UAS-NAS Integrated Human In The Loop simulation
- The review will focus on
  - Configuration of the Distributed Test Environment infrastructure developed to support the three IHITL Test Set-ups, including any known issues, limitations, or concerns
  - Readiness of the UASNAS Technical Team to support the IHITL Simulation by verifying that test LVC-DE is ready to support, support personnel, and test procedures are ready for testing and data acquisition, reduction, and control
- This review will serve as the Experiment review for Test set-up 2 (Pilot Acceptability of SAA Maneuvers)
  - Summary review of Test Set-up 1 (Controller Acceptability of SAA Maneuvers) and Test set-up 3 (Acceptability of SAA Advisories) experiment reviews will be presented for background and context information
- This review will serve as the SimLabs (Ames) Readiness Review

TRR Entrance / Exit Criteria
FDR Closeout

Mike Brignola

7123.1b

Entrance Criteria	Success/Exit Criteria
1. The objectives of the testing have been clearly defined and documented, and all of the test plans, procedures, environment, and configuration of the test item(s) support those objectives. 2. Configuration of the system under test has been defined and agreed to. All interfaces have been placed under configuration management or have been defined in accordance with an agreed to plan, and a version description document has been made available to TRR participants prior to the review. 3. All applicable functional, unit-level, subsystem, system, and qualification testing has been conducted successfully 4. All TRR-specific materials, such as test plans, test cases, and procedures, have been available to all participants prior to conducting the review. 5. All known system discrepancies have been identified and disposed in accordance with an agreed-upon plan. 6. All previous design review success criteria and key issues have been satisfied in accordance with an agreed-upon plan. 7. All required test resources/people (including a designated test director), facilities, test articles, test instrumentation, and other test enabling products/have been identified and are available to support required tests. 8. Roles and responsibilities of all test participants are defined and agreed to. 9. Test contingency planning has been accomplished, and all personnel have been trained.	1. Adequate test plans are completed and approved for the system under test. 2. Adequate identification and coordination of required test resources are completed 3. Previous component, subsystem, and system test results form a satisfactory basis for proceeding into planned tests. 4. Risk level is identified and accepted by program/competency leadership as required. 5. Plans to capture any lessons learned from the test program are documented. 6. The objectives of the testing have been clearly defined and documented, and the review of all the test plans, as well as the procedures, environment, and configuration of the test item, provides a reasonable expectation that the objectives will be met. 7. Test cases have been reviewed and analyzed for expected results, and the results are consistent with the test plans and objectives. 8. Test personnel have received appropriate training in test operation and safety procedures.

TRR Entry Status

IHITL TRR Entrance Criteria	Satisfied (Yes/No)	Notes
1. The objectives of the testing have been clearly defined and documented, and all of the test plans, procedures, environment, and configuration of the test item(s) support those objectives.	Y	Objectives slide 14 IHITL V&V Plan (5/2014) IHITL Data Analysis Plan (5/2014) IHITL Simulation Test Plan (5/2014) HSI Ames Experiment Review slide 17 SSI Ames Experiment Review slide 54 SSI LaRC Experiment Review slide 67
2. Configuration of the system under test has been defined and agreed to. All interfaces have been placed under configuration management or have been defined in accordance with an agreed to plan, and a version description document has been made availa	Y	Final Design Review slide 10 Document status slide 12 IHITL system baseline CCB 4/2014
3. All applicable functional, unit-level, subsystem, system, and qualification testing has been conducted successfully	Y	LVC verification RGCS verification Distributed Test Environment validation
4. All TRR-specific materials, such as test plans, test cases, and procedures, have been available to all participants prior to conducting the review.	Y	posted on Knowledge Now: - WBS 5.1 IT&E\Reviews Mtgs & Presentations\ TRR Document status slide 12
5. All known system discrepancies have been identified and disposed in accordance with an agreed-upon plan.		Applicable Open DR's slide 11 Applicable Open CCR's slide 11
6. All previous design review success criteria and key issues have been satisfied in accordance with an agreed-upon plan.		FDR closeout slide 10 (open) HSI Ames Experiment Review - approval in this brief slide 17 SSI Ames Experiment Review slide 54 SSI LaRC Experiment Review slide 67
7. All required test resources/people (including a designated test director), facilities, test articles, test instrumentation, and other test enabling products/have been identified and are available to support required tests.	Y	IT&E ORD-01 (3/2014) IHITL Simulation Test Plan (5/2014) IHITL Config1 weekly TIM (4/2-6/4/2014)
8. Roles and responsibilities of all test participants are defined and agreed to.	Y	Test roles slide 36, 92-102
9. Test contingency planning has been accomplished, and all personnel have been trained.	Y	Contingency staffing and testing Pilot confederate training (complete) Pilot subject training (upon arrival) Controller subject training (upon arrival) Test staff training slide 102, 114 Control Room Safety Training slide 114

Final Design Review RFI Status & Closeout

- Reference IHITL Delta DR RFI status as of 20140520 Excel sheet
- 17 RFI's and 4 Observations from the IRT
- To date:
  - 15 RFI's and 4 Observations answered and closed by originators
  - 2 RFI closures pending CONOPs update/baseline
- Status Summary
  - Full RFI closure pending document updates:
    - CONOPs (POC: Sam Kim)
      - Risk = minimal with CONOPs communicated in FDR slides
  - Full FDR closeout pending:
    - RFI closure
    - Baseline of CONOPs and DTE ICD-01 (POC: Sam Kim)
      - Risk = minimal with draft Distributed Test Environment ICD available
    - Debra's approval

Open CCR's
5/27/14

Items require closure prior to TRR.

DR	CCR	STR	Title	Assigned To	Status	Expected Closure
13-103	13-232	13-324	Ames MACS Trafic Not Displayed on DFRC MACS	Hernandez	Open	
	14-237	14-327	Build/Install New SAA Process Host Comps	Code ME	Open	
	14-239	14-329	LVC Software Upgrade for Test Only	Willhite	Closed	5/13/14
	14-241	14-331	Baseline LVC IHITL Test Software	Willhite	Open	
	14-248		Place DTE ICD-01 Document Under CM	Kim	Pending	
	14-253	14-335	Install Plexcomm S/W on RGCS	Hoffman	Open	
	14-254	14-334	Install Office and Filezilla on LVC Computers	Walters	Open	5/22/14
	14-255	14-336	Install Plexcomm S/W on LVC	Hoffman	Open	
	14-256		Install Data Collection Software	Koshimoto	Open	
	14-257		Install SAA Proc Update Software	Hoffman	Open	
	14-258		Install VSCS to Version 5.XXX	Sanner	Closed	5/13/14
14-105	14-259	14-338	NTP Client Update Problems	Patterson	Open	
	14-260	14-340	Update Ikhana LVC Messages	Patterson	Open	Not for IHITL
	14-261	14-337	LVC Security Updates for May	Walters	Open	
	14-262	14-339	Install HTOP Software	Walters	Closed	5/13/14
	14-264		Install updated MACS scenario simulation files	Willhite	Open	
	14-266		Install update to Data Processor software	Willhite	Open	
	14-267		RGCS Baseline Document pre-IHITL Cumulative Update 1	Sanner	Open	
	14-268		Install the data logger software on gateway2	Willhite	Open	
	14-269		Install the required PLEXComm software on LVC Computers in support of the Plexsys Virtual Radio installation	Hoffman	Open	
	14-270		Baseline IT&E ConOps	Kim	Pending	
	14-271		Update VSCS to version 5.5.50013	Sanner	Open	
	14-272		Update to SaaProc Software	Otto	Open	

Document Status

Documents Required through IHITL		5/29/2014			
Document	**Doc #**	**POC**	**Baselined at SRR/SWRR /FDR**	**STATUS/COMMENTS**	
UAS/NAS Project Requirements Document	UAS-PRO-1.1-005-001 (May-14)	Dan Roth	Baseline Review	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=662514	
IT&E Concept of Operations	IT&E Conops-01	Sam Kim	FDR	DRAFT STARTED	
IT&E Objectives and Requirements Document	IT&E ORD-01 (MARCH 14)	Mike Brignola	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=652199	
IT&E ACAS-Xu ORD	IT&E ORD-02	Mike Brignola	Baseline Review	NOT FOR IHITL-NEED ACAS	
IT&E Project Plan	IT&E PP-01 (APR 14)	Heather Maliska	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=651633	
System Requirements Documents	LVC SRD-01 REV B (MARCH 2014)	Jamie Willhite	SRR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=652223	
	RGCS SRD-01 REV A (MARCH 2014)	Kurt Sanner	SRR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=653173	
	UAS SRD-01 (JAN-14)	Mike Marston	SRR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=620546	
Software Requirements Documents	LVC SWRD-02 REV B (MARCH 2014)	Jamie Willhite	SWRR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=652226	
	RGCS SWRD-01	Kurt Sanner	FDR	NOT FOR IHITL-NEED FT3	
Interface Control Documents	LVC ICD-01 (IKHANA DATA READER) (AUG-13)	Jamie Willhite	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=616729	
	LVC ICD-02 (ADS-B INTERFACE)	Jamie Willhite	FDR	NOT FOR IHITL-NEED FT3	
	LVC ICD-03 (GATEWAY) REV A (MARCH-14)	Srba Jovic	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=660217	
	DTE ICD- 01 (DISTRIBUTED TEST ENVIR)	Mike Dandachy	FDR	DRAFT	*
	RGCS ICD-01 (Intra RGCS) (APRIL 14)	Kurt Sanner	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=653585	
	RGCS ICD-02 (Inter RGCS) (APRIL 14)	Kurt Sanner	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=653587	
	UAS ICD-01	Mike Marston	FDR	NOT FOR IHITL-NEED FT3	
V&V Plans	IHITL V&V-01 (May-14)	Jim Murphy	FDR	https://nsckn.nasa.gov/DMS/FolderDocs.aspx?Filter=124&FolderID=152717	*
	LVC V&V-01 (JAN 14)	Jamie Willhite	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=657757	
	RGCS V&V-01 (May-14)	Kurt Sanner	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=664287	
	UAS V&V-01	Mike Marston	FDR	NOT FOR IHITL-NEED FT3	
RGCS IHITL Test Plan	RGCS-IHITL-TP-01 (May-14)	Kurt Sanner	TRR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=664286	
IHITL Simulation Test Plan	IHITL SIM TP-01 Rev A (May-14)	Neil Otto	TRR	https://nsckn.nasa.gov/DMS/FolderDocs.aspx?Filter=124&FolderID=152717	*
Risk Management Plan	IT&E RMP-01 (May-14)	Jen Hinckley	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=665161	
Configuration Management Plan	IT&E CMP-01 Rev B (FEB-14)	J. Weigelt	SRR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=629634	
Software Development Plans	IT&E SDMP-01 (MAR 14)	J. Murphy	SWRR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=643147	
	LVC SDP-01 (JAN-14)	Jamie Willhite	SWRR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=630232	
	ADS-B SDP-01 (JAN-14)	Ricardo Arteaga	SWRR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=621802	
IHITL Data Analysis Plan	IT&E DAP-01 (May-14)	Kim/Murphy	TRR	https://nsckn.nasa.gov/DMS/FolderDocs.aspx?Filter=124&FolderID=152717	*
Architecture Description Document	IT&E ADD-01 (APRIL 14)	Brignola/Saltzman	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=660364	
Safety and Mission Assurance Plan	IT&E SMA-01 (FEB 13) (REV B IN REVIEW)	Cross	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=616893	
Mishap Preparedness and Contingency Plan	IT&E MPC-01 (MAR 14)	Cross	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=637507	
LVC/RGCS Safety Plan	IT&E LSP-01 (May-14)	Cross	TRR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=665248	
LVC Software Design Description	LVC SWDD-03 REV A (FEB 14)	Jovic	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=649053	
RGCS System Baseline	RGCS SBL-01 REV A (MAY 14)	Victor Loera	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=663417	
IT&E Product/Specification Tree	IT&E PST-01 (DEC-13)	Mike Brignola	FDR	https://nsckn.nasa.gov/DMS/ViewDoc.aspx?DocID=616891	
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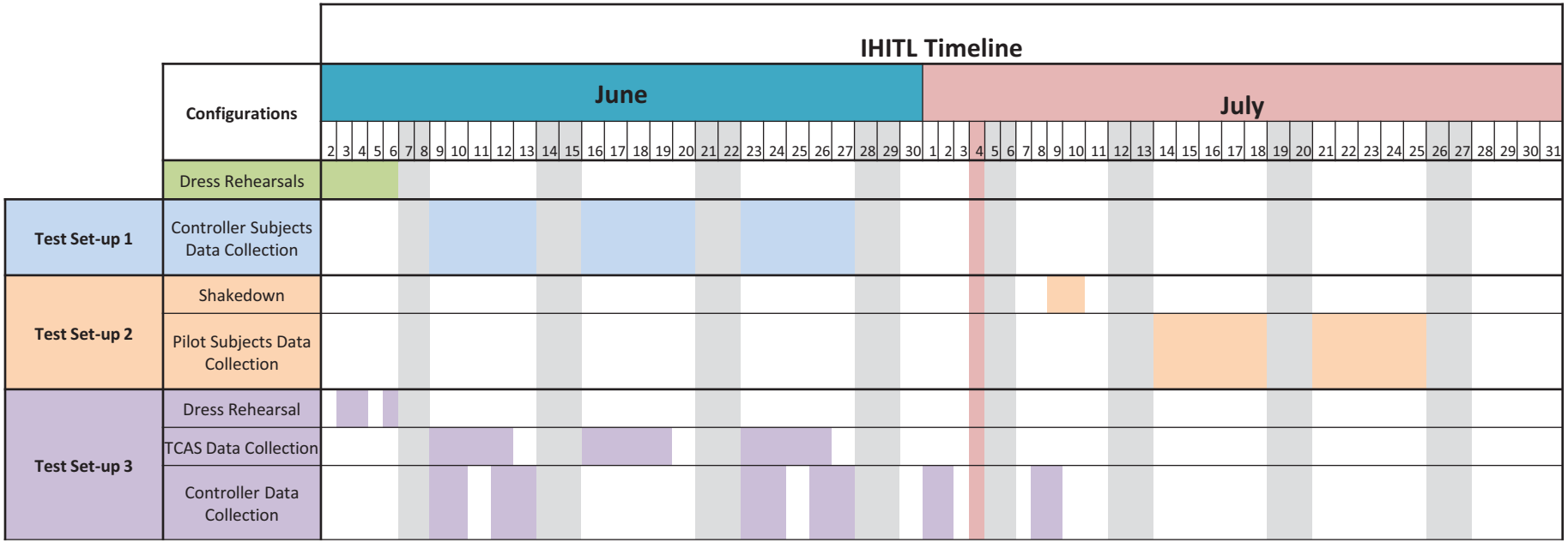
IHITL Objectives Schedule

Jim Murphy

IHITL Goals and Objectives

- Goals
  - Integrate and evaluate the state of UAS concepts and supporting technologies defined within the scope of the UAS in the NAS Project. Identify areas of future research and development emphasis and reduce risk for the flight tests and capstone event
  - Evaluate and measure the effectiveness and acceptability of the SAA algorithms and displays to inform and advise pilots of UAS aircraft and air traffic controllers
- High Level Objectives
  - Integrate and evaluate the state of UAS concepts and supporting technologies defined within the scope of the UAS in the NAS Project as a function of traffic scenarios
  - Evaluate the pilot and controller acceptability of UA maneuvers in response to SAA advisories
  - Assess the impact of wind uncertainty on the execution of SAA advisories as well as interoperability with TCAS equipped aircraft
  - Assess the impact of communication delay and wind uncertainty on the air traffic controller workload and acceptability of SAA self-separation maneuvers.
  - Evaluate the acceptability and performance of the LVC to provide a relevant environment
  - Collect data to improve batch simulation models (Test Setup 1 and 2)

IHITL Timeline



- Test Set-ups 1 and 3 run concurrently
  - Test Set-up 3 has 2 test conditions that run concurrently
  - Test Set-up 2 is taking a break during SARP in mid-June
    - Eating into Make-up days
  - Test Set-up 1 can extend into 30 June week if necessary
    - Not desired, Holiday week and prep for Test Set-up 2
- Test Set-up 2
  - Make-up days 28 July week

IHITL Experiment Reviews

- Experiment Reviews
  - Controller Acceptability of SAA Maneuvers (Test Setup 1)
    - Completed May 19th
    - Summary to follow
  - Acceptability of SAA Advisories (Test Setup 3)
    - Completed May 15th
    - Summary to follow
  - Pilot Acceptability of SAA Maneuvers (Test Setup 2)
    - Experiment Review to be conducted as part of this TRR
    - Conrad Rorie to present

HSI iHitL Experiment Review

Pilot Subjects ("Configuration 1, Test Setup 2")

- **30 MAY, 2014**

Jay Shively, HSI PE
Lisa Fern, HSI
Conrad Rorie, HSI
Confesor Santiago, SSI PE
Eric Mueller, SSI

Overview

- Objective(s)
- Experimental Design
- Procedure
- Data Analysis
- Roles and Responsibilities
- Success Criteria

Objectives

- Leverage the lessons learned from PT4 to continue the evaluation of candidate Sense and Avoid (SAA) Self-Separation (SS) and Collision Avoidance (CA) displays and algorithms
  - Examine the effects of advanced traffic display elements and tools on pilots' ability to maintain well clear
    - Tools selected based on preliminary and subjective reports from participants in PT4
- Examine the effects of different sensor ranges on pilots' ability to maintain well clear
  - Unlike PT4, will model 2 separate sensors with markedly different performance characteristics

Objectives

- Rationale
  - PT4 compared a ‘Basic’ display configuration to a suite of ‘Advanced’ features
    - iHitL design will allow us to measure any differences between specific display features and determine the implications of their presence or absence in the GCS
  - Non-cooperative traffic are a major consideration in the development of SAA systems
    - The presence of non-cooperative aircraft provides a more realistic environment
    - Limited surveillance range and field of regard may have significant impact on pilot performance and behavior

Objectives

- Lessons Learned:
  - Based on observations during PT4 data collection, subjective questionnaires, and pilot debriefs, several improvements have been instantiated by AFRL & SSI:
    1. VSCS (AFRL)
       - Control and navigation interface made more intuitive
       - Aircraft responds more consistently with pilot expectations
       - Ineffective/unused Advanced features removed to reduce clutter
    2. AutoResolver/SAA Proc (SSI)
       - Algorithm logic modified to recommend fewer extreme maneuvers
       - 'Push point' calculation optimized to make trial planning tool more responsive and accurate

Objectives

- Additional Functionality
  - SSI and IT&E were able to exploit an existing field in the LVC Gateway to identify whether a target is cooperative or non-cooperative
  - Those identified as non-cooperative will be picked up by simulated airborne radar (modeled on Partner airborne radar)
    - ADS-B Equipped
      - Range = **80nm** & **+/- 5000ft**
    - Non-Equipped Aircraft
      - Range = **6nm**
      - Azimuth = **+/- 110deg** (from nose)
      - Elevation = **+/- 20deg** (from horizontal)
  - Non-cooperative will use same symbology as cooperative aircraft within Vigilant Spirit
    - May not be assigned a callsign

Experimental Design

- One-Way Repeated Measures Factorial
  - Display Information Level (4 Level; Within Subjects)
    - Configuration 1: Advanced Display with Information Only
    - Configuration 2: Advanced Display with Information + Vector Planner
    - Configuration 3: Advanced Display with Information + Auto Resolutions
    - Configuration 4: Advanced Display with Information + Vector Planner + Auto Resolutions
      - Roughly same as 'Advanced' suite in PT4
- Embedded Variable
  - Track Type (manipulated within each scenario; not counterbalanced)
    1. Cooperative Traffic (ADS-B-equipped)
    2. Non-Cooperative Traffic
- Participants
  - 5 active California Air National Guard (163rd Reconnaissance Squadron) MQ-9 (Reaper) pilots
  - 5 active Beale Air Force Base RQ-4 (Global Hawk) pilots

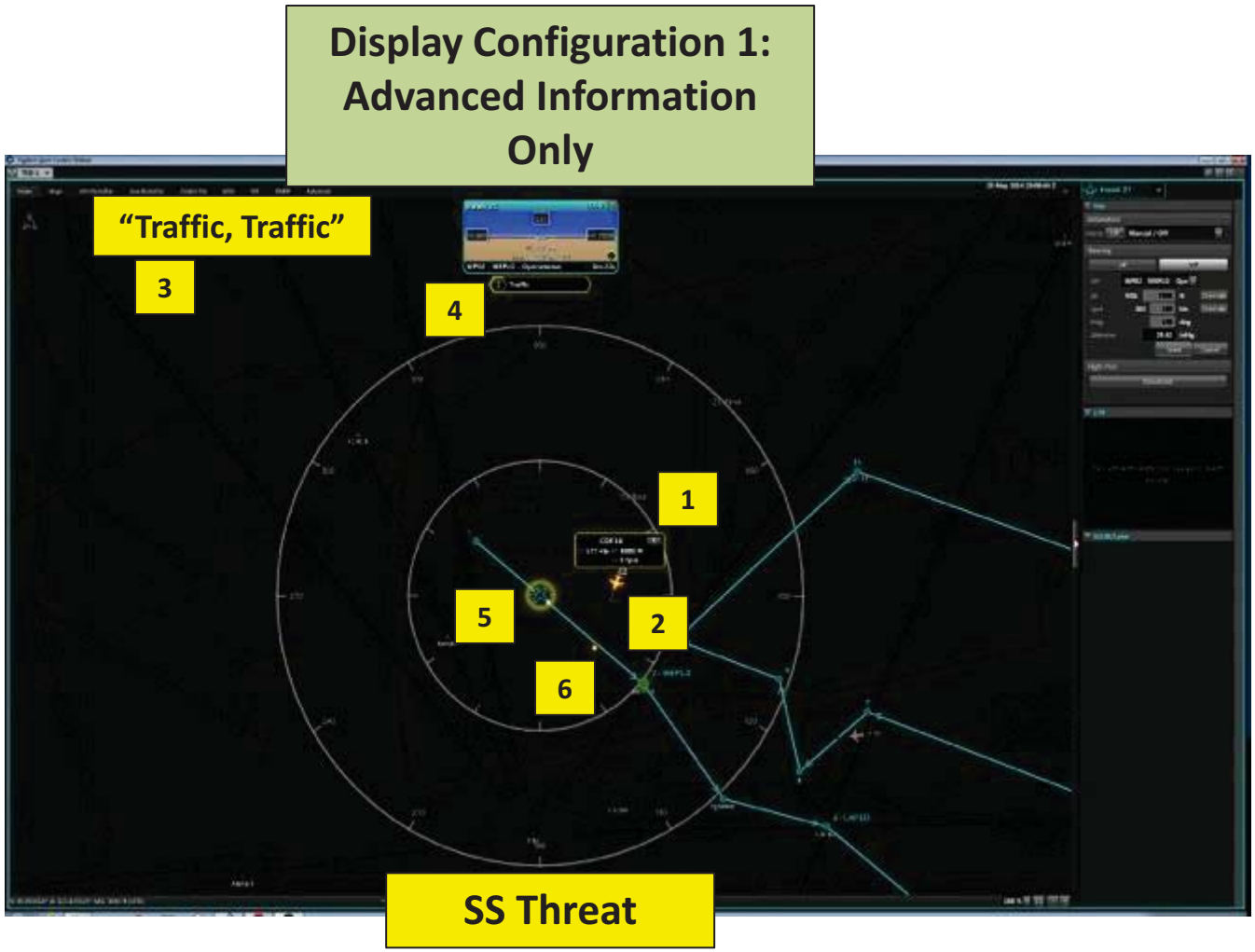
Experimental Design

- Display Configuration will be counterbalanced between participants
- Track Type (cooperative vs. non-cooperative) will be manipulated *within each scenario*
- Encounters
  - Plan to have 8 encounters with ownship per run
    - 4 encounters will involve a non-cooperative AC

Pilot #	Trial 1	Trial 2	Trial 3	Trial 4
1	Display Configuration 1	Display Configuration 2	Display Configuration 4	Display Configuration 3
2	Display Configuration 2	Display Configuration 3	Display Configuration 1	Display Configuration 4
3	Display Configuration 3	Display Configuration 4	Display Configuration 2	Display Configuration 1
4	Display Configuration 4	Display Configuration 1	Display Configuration 3	Display Configuration 2
5	Display Configuration 1	Display Configuration 2	Display Configuration 3	Display Configuration 4
6	Display Configuration 2	Display Configuration 3	Display Configuration 4	Display Configuration 1
7	Display Configuration 3	Display Configuration 4	Display Configuration 1	Display Configuration 2
8	Display Configuration 4	Display Configuration 1	Display Configuration 2	Display Configuration 3
9	Display Configuration 1	Display Configuration 2	Display Configuration 3	Display Configuration 4
10	Display Configuration 4	Display Configuration 3	Display Configuration 2	Display Configuration 1

Procedure

- Alert Information
  1. Data Tag launches automatically
     - Callsign (for ADS-B equipped AC)
     - Groundspeed
     - Altitude
     - Vertical Velocity
  2. Intruder color-coded based on predicted threat level
  3. Auditory alert
     1. "Traffic, Traffic" for SS
     2. "Left/Right/Climb/Descend" for CA
  4. "Traffic" tag presented below Baseball Card
  5. Color-coded halo appears around ownship
  6. Closest Point of Approach Location



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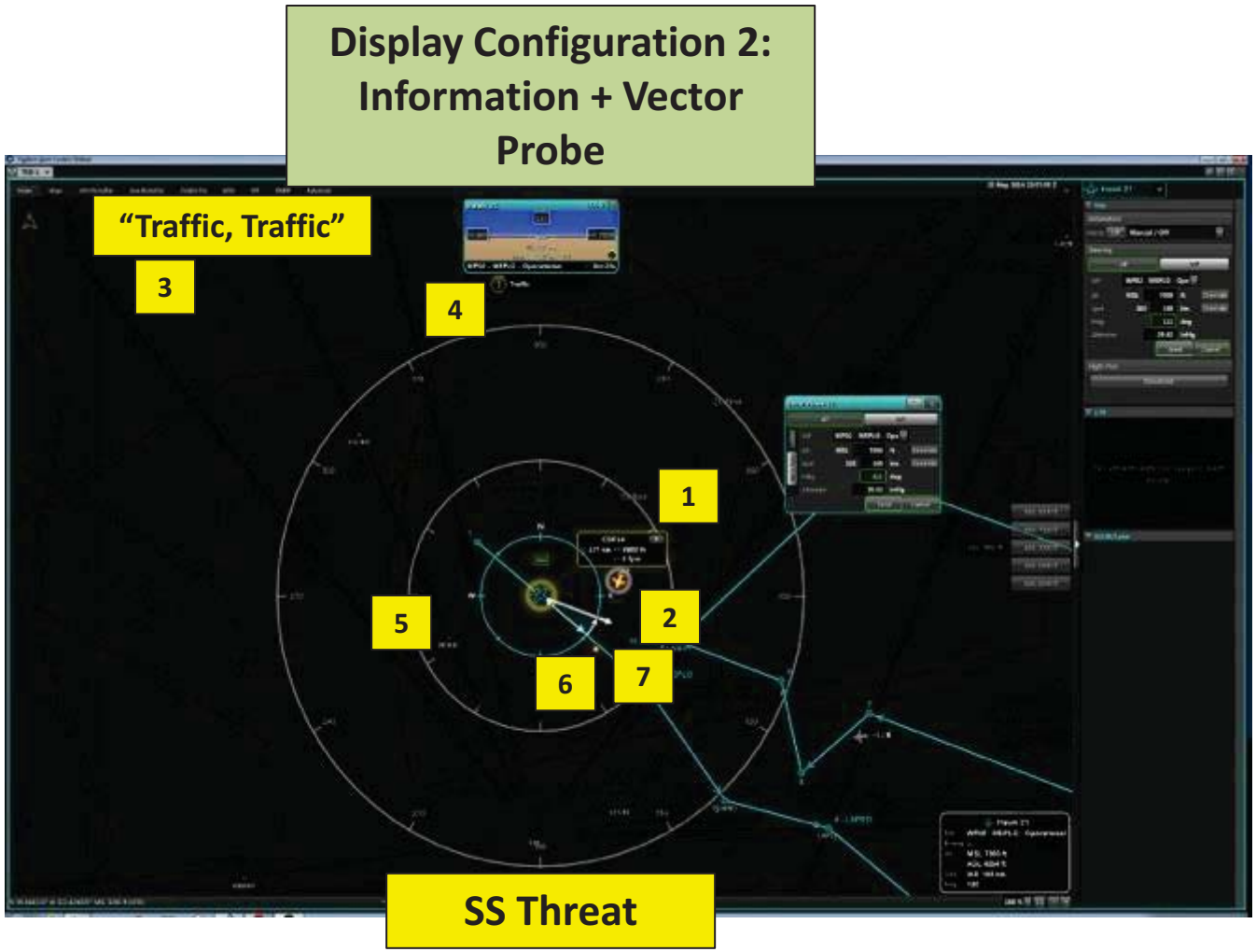
  6. Closest Point of Approach Location
  7. Vector Probe available for use



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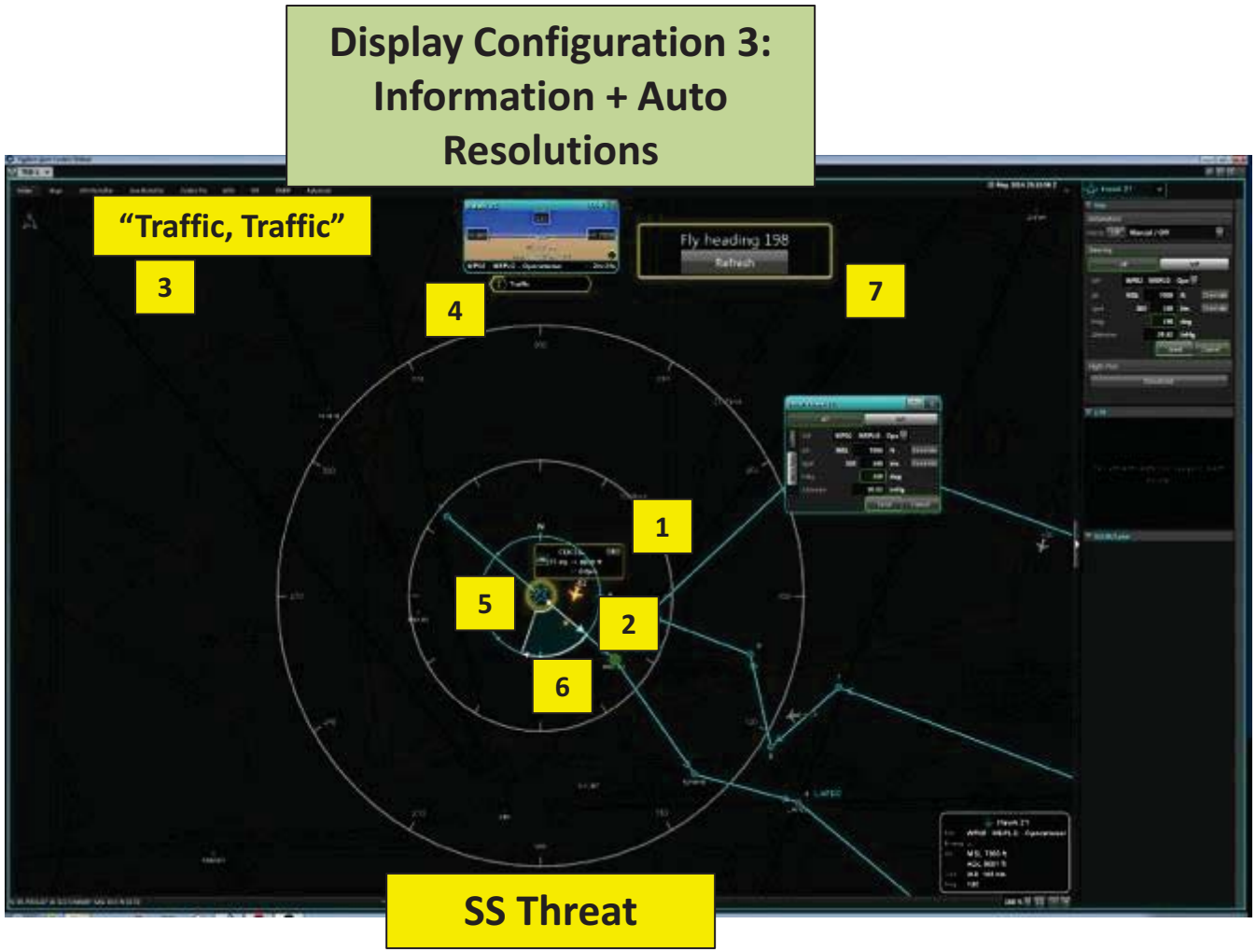
  6. Closest Point of Approach Location
  7. Auto Resolution provided to right of baseball card



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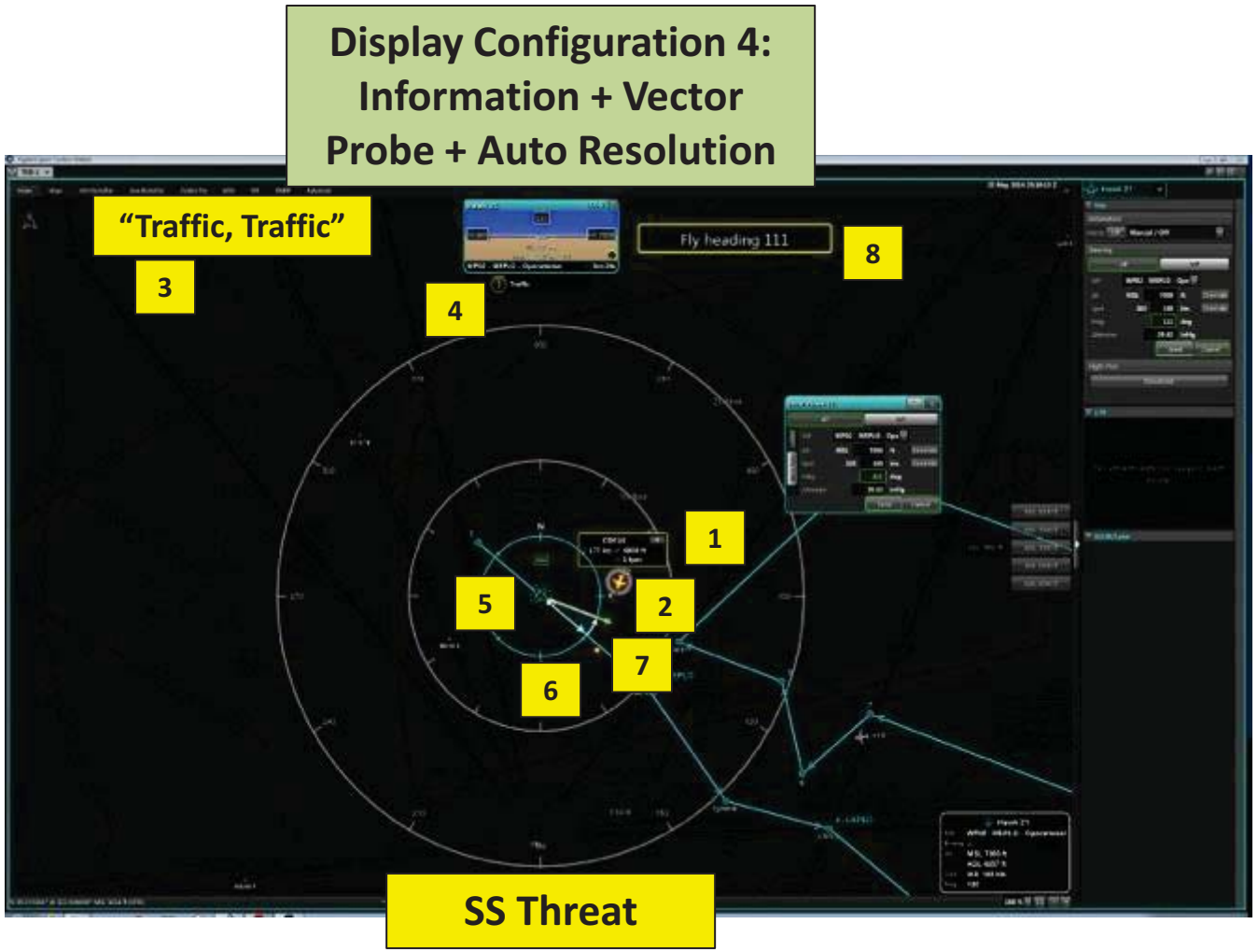
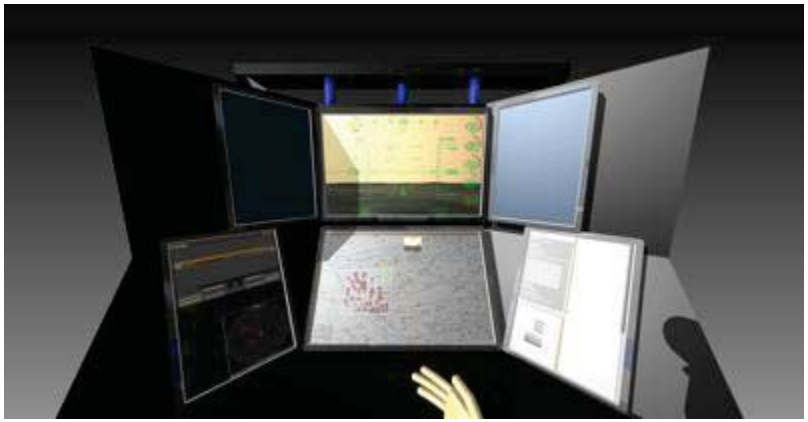


Procedure

Pilots will see all four display conditions throughout the day

- Pilot Tasks:
  1. Fly HAWK21 along pre-filed path (Fire Line)
     1. Only responsible for navigating the aircraft
     2. Requires interaction with the GCS and coordination ATC
  2. Comply with ATC clearances and traffic display alerts to maintain safety of flight
     - 2 levels of alert (similar in structure to TCAS II):
       - Self Separation Alert (similar to TA) – pilot uses discretion in deciding if/how to maneuver
       - Collision Avoidance Alert (similar to RA) – pilot instructed to immediately comply with presented RA
     - Return to mission route and altitude as often as possible
  3. Monitor and respond to chat and health/status tasks



Research GCS Layout at NASA Armstrong

Procedure

- General Parameters
  - Flying Instrument Flight Rules
    - Standard separation requirements
      - 500ft vertical separation with VFR
      - 1000ft vertical separation with IFR
    - ATC has been provided with documentation of flight plan
      - Pre-approved for mission altitude only
  - Operating UAS for a portion of its flight
    - UAS/GCS will launch en route (at mission altitude)
      - No takeoff or landing
    - Appropriate flight plan will be pre-loaded
      - UAS will launch in transit from WP01 to WP02

Deviations from mission route or altitude require coordination with ATC – unless there is a safety of flight concern

Procedure

- UAS Scenario (38min)
  - UAS: Predator B
  - Airspace: ZOA 40/41
    - Class A & E with mixed IFR/VFR traffic
    - Manned traffic modeled using real traffic data
    - 2 separate traffic scenario files
  - Secondary tasks:
    - 'Chat' directed
      - "Mission" Radio Frequency changes
      - Radial and Distance check
      - Nominal information requests (e.g., fuel level remaining)
    - System Alerts
      - Generator Failure (checklist)
      - Tanker Header Overpressure (checklist)
      - Annunciator checks

Procedure

Run Schedule

Time	Task	Duration
0800	Introduction / Pilot Briefing	20
0820	VSCS Training	30
0850	VSCS Practice	30
0920	Break	10
0930	Advanced Display Training	20
0950	Advanced Display Practice	20
1010	System Reset	5
1015	Advanced Display Data Collection	40
1055	Post Trial Forms	10
1105	Break	10
1115	Advanced Display Training	10
1125	Advanced Display Practice	20
1145	System Reset	5
1150	Advanced Display Data Collection	40
1230	Post Trial Forms	10
1240	Lunch	60
1340	Advanced Display Training	10
1350	Advanced Display Practice	20
1410	System Reset	5
1415	Advanced Display Data Collection	40
1455	Post Trial Forms	10
1505	Break	10
1515	Advanced Display Training	10
1525	Advanced Display Practice	20
1545	System Reset	5
1550	Advanced Display Data Collection	40
1630	Post Trial Forms	10
1640	Debrief	20
1700	End	

Procedure

- Multi Aircraft Control System (MACS)
  - Stationed at NASA Ames
  - A retired Air Traffic Controller will be managing UAS and manned traffic within ZOA40/41
    - Sector traffic modeled using real sector activity and data
  - Pseudo-pilots monitoring and managing all manned traffic (IFR & VFR)
  - ATC and pseudo-pilots communicating over frequency 118.42

Air Traffic Control Station (MACS)

Pseudo Pilot Station

Data Analysis

- Real Time Intruder Data:
  - Vertical Distance
  - Lateral Distance
  - Slant Range
  - Predicted Closest Point of Approach (CPA)
  - Slant range to CPA
  - Time to loss of well clear
  - Threat events
- Post Process Intruder Data:
  - Well Clear Violations
  - NMAC Violations
  - Time in threat levels
  - Min distance to intruder (vertical, lateral, slant)
  - Min CPA
  - Min distance to Well Clear Violation
- Subjective Questionnaires
  - NASA-TLX
  - Post Trial
  - Post Sim
- Pilot Performance, Primary Task (Post Process)
  - RT to threats (initial Initiate action)
  - Edit/input RT
  - Upload RT
  - Correctness of maneuver (compared to recommended maneuver)
  - Size of maneuver
  - Secondary threats
  - Comm Data
- Pilot Task Performance, Secondary Task (Post Process)
  - deviations from flight plan
    - RMS error from initial route
    - Time off route
  - RT/accuracy for chat tasks
  - RTto health and status alerts, etc.
  - RT/accuracy to measurement task

Data Analysis

- Data will be analyzed using a One-Way Repeated Measures Factorial ANOVA
  - Pilot Measured Response
    - Time to Reply to ATC
    - Time to Initiate Edit
    - Time to Edit
    - Time to Upload
  - # of Well Clear Violations
  - Closest Point of Approach (CPA)
  - Size of Resolution Maneuver
  - Tool Use (did pilots use Vector Probe/Auto Resolver?)

Roles and Responsibilities

		Integration Check		Pre-Test/Shakedown		Final Test
Location	Staffing Requirements	7-Jul-2014	8-Jul-2014	9-Jul-2014	10-Jul-2014	11-Jul-2014
Armstrong	Researcher (Conrad)	X	X	X	X	X
	Sim Manager (AFRC; Jamie)	X	X	X	X	X
	Engineering Support (Victor?)	X	X	X	X	X
	UAS Pilot			NASA Pilot	NASA Pilot	
Ames	Sim Manager (ARC; Neil?)	X	X	X	X	X
	Engineering Support (Mohamad?)	X	X	X	X	X
	Controller (Confederate)	X	X	X	X	X
	Ghost Controller (Wayne)	X	X	X	X	X
	Ghost Pilot (Jacob)	X	X	X	X	X
	Pseudo Pilot 1 (Confederate)	X	X	X	X	X
	Pseudo Pilot 2 (Confederate)	X	X	X	X	X
	Pseudo Pilot 3 (Confederate)	X	X	X	X	X
	Pseudo Pilot Observer (Sabrina?)	X	X	X	X	X

		Data Collection									
Location	Staffing Requirements	14-Jul-2014	15-Jul-2014	16-Jul-2014	17-Jul-2014	18-Jul-2014	21-Jul-2014	22-Jul-2014	23-Jul-2014	24-Jul-2014	25-Jul-2014
Armstrong	Researcher (Conrad)	X	X	X	X	X	X	X	X	X	X
	Sim Manager (AFRC; Jamie)	X	X	X	X	X	X	X	X	X	X
	Engineering Support (On Call; Victor?)	X	X	X	X	X	X	X	X	X	X
	UAS Pilot	ANG	ANG	ANG	ANG	ANG	BEALE	BEALE	BEALE	BEALE	BEALE
Ames	Sim Manager (ARC; Neil?)	X	X	X	X	X	X	X	X	X	X
	Engineering Support (On Call; Mohamad?)	X	X	X	X	X	X	X	X	X	X
	Controller (Confederate)	X	X	X	X	X	X	X	X	X	X
	Ghost Controller (Wayne)	X	X	X	X	X	X	X	X	X	X
	Ghost Pilot (Jacob)	X	X	X	X	X	X	X	X	X	X
	Pseudo Pilot 1 (Confederate)	X	X	X	X	X	X	X	X	X	X
	Pseudo Pilot 2 (Confederate)	X	X	X	X	X	X	X	X	X	X
	Pseudo Pilot 3 (Confederate)	X	X	X	X	X	X	X	X	X	X

- 7 JULY – 11 JULY will be testing and practice
- 14 JULY – 25 JULY will be data collection
- Researchers and confederates will be stationed at AFRC and ARC

Success Criteria

- Generate at least half of the encounters in all four trials for each pilot participant
  - Allows HSI to analyze effects of Display Configuration and Track Type by studying rates of well clear violations
- Pilot responds to well clear threats by interacting with GCS and coordinating/communicating with ATC
  - Allows HSI to record the pilots' measured response
- Pilot completely fills out subjective questionnaires in a timely manner (within 20min of scenario completion)
  - Allows HSI to analyze impact of scenarios on participants level of acceptability and workload

Questions?

- Division Approval?

BACKUP SLIDES

Test Setup 1 Experiment Summary

Confesor Santiago

Objectives:

- Evaluate the acceptability to the controller of maneuvers performed for “self-separation” in order to remain “well-clear” of other traffic

- Collect data that improves modeling of controller performance in batch non-real-time simulations

Success Criteria

- Evaluate the acceptability to the controller of maneuvers performed for "self-separation" in order to remain "well-clear" of other traffic
  - Procedure comparison in which SS maneuvers are or are not coordinated with ATC before execution is successful at informing whether coordination should be required (or not).
  - Maneuver and scripted deviation magnitude the controllers (1) detect and (2) object to are recorded and used to evaluate ATC acceptability.
  - Data to support DAA use conops for RTCA SC-228 Ops sub-group is collected.

- Collect data that improves batch simulations
  - The time required for controllers to approve or disapprove self-separation maneuvers is collected and used to improve model.
  - Controller-approved maneuvers are recorded and used to improve self-separation algorithm recommendations.
  - Time and distance thresholds and airspace/scenario circumstances at which ATC issues traffic advisories are recorded and used to improve models.

Test Conditions

- UAS pilot using ground control station (confederate)
- Virtual manned and unmanned background traffic (confederate)
  - Mix of IFR and VFR (simulated cooperative and non-cooperative sensors)
  - Flown by pseudo-pilots
- Single sector of interest (controller subject)
  - Fifteen recently retired air traffic controllers
  - Retired within last five years
  - Enroute or TRACON experience acceptable
- Adjacent sectors staffed with confederate controller to:
  - Conduct handoffs
  - Ensure scripted encounters do not get perturbed and remain realistic
- Scripted scenarios over ZOA (sector 40/41 combined) low-altitude airspace
  - Loss of “well-clear” encounters (10 per run)
  - Traffic density/workload (light-to-moderate, moderate, high)
  - Maneuver deviations for non-encounter aircraft
- Three weeks of data collection, 5 days a week, one subject a day
  - June 9-27
  - Each controller subject will be trained morning of data collection
  - Participant scripts have been written and are ready

Experiment Review Outcome

- Experiment Review – Monday, May 19, 2014
  - NASA Ames standard experiment review process for when human subjects are involved
  - Approximately 2 hours (briefing and Q&A)
- Review Panel (Ames – Code AF)
  - Miwa Hayashi, Tom Kozon, Sandy Lozito, Savvy Verma, and Kathy Lee
- Also in attendance…
  - Fellow AF colleagues
  - UAS-NAS subprojects and Project Office
- Presented in-depth detail of experiment plan
- Outcome
  - **Approved to execute the experiment (mgmt and review panel)**
  - No changes to experiment design
  - Numerous comments/suggestions
  - IRB completed

Experiment Review Feedback

- Concerns about the number of simulated encounters
  - Two SME verified encounters are typical/realistic for given airspace
  - Encounters are counter-balanced across scenario
  - Encounter count falls within realistic ATC work-load

- Concerns with scenario complexity assessment
  - Used SME to verify complexity assessment

- Suggested additional situational awareness metric
  - Taken into account additional metric to record ATC subjective work-load estimates

Data Analyses

- Observers will note whether the controller contacted the pilot or pointed out the deviation, and when traffic advisories were given
  - Observations will be scanned at the end of each day for data security
  - Data will be transcribed into electronic version, and processed using analysis tools (e.g. Matlab, Excel)
- Questionnaires for the controller subjects will be administered at the end of each run
  - Questionnaires will be scanned at the end of each day
  - Subjective data will be transcribed into electronic version for later processing
- Encounter-specific data (e.g. closest point of approach, conflict start time) will be recorded in log files
  - Logs files will be archived each day from the computer used to administer the experiment
  - Data will be analyzed with post-processing scripts using log files as direct input
- At the end of this experiment, all data will be analyzed to achieve the aforementioned success criteria of the test objectives.
  - Lessons learned and modeling improvements will be drawn out and used to inform future simulations and flight tests

BACKUP SLIDES

Traffic Scenarios and Levels

- Four scenarios derived from previous experiment (PT4) with modifications
  - Each scenario contains ten IFR-VFR aircraft "encounters"
    - Five encounters between UAS and VFR aircraft
    - Five encounters between manned IFR and VFR aircraft
  - UAS aircraft
    - Predator B as simulated by VSCS/RGCS
    - Range of other aero characteristics based on manned aircraft types
  - VFR traffic in three types
    - Receiving air traffic services with an operational transponder
    - Not receiving air traffic services but possessing an operational transponder
    - Not receiving air traffic services and not possessing a transponder ("primary target")
- Traffic complexity determined by aircraft density and requirement to maintain a "miles-in-trail" restriction for aircraft entering NorCal TRACON

Scenario	Workload	Complexity	Additional Services Impacted
C-1	Moderate	Not difficult	Yes
C-2	Light to Moderate	Not difficult	Yes
C-3	Heavy	Difficult	Yes
C-4	Moderate	Difficult	Yes

Subjects

- Fifteen recently retired air traffic controllers
  - Retired within last five years
  - Enroute or TRACON experience acceptable
- Instructions
  - Issue TAs to appropriate aircraft as you see fit
    - Remind them that they should do so when “separation may reduce below the applicable standard, … or place aircraft in unsafe proximity”
    - Primary-only targets should all be below 10,000 ft, but remember that issuing TAs to aircraft receiving air traffic services for all know intruders is an important additional service
    - [other standard ATC separation services also referenced during training]
  - To help us improve simulation fidelity, please point out any simulation or scenario inconsistencies, problems, concerns, bugs, etc. during the run.
    - The observer will note these and follow up with any additional details you wish to provide at the end of the run.
    - The pseudo-pilot adherence to real operations is important, please point out any time they don’t conform to your expectations or it raises your workload/increases complexity.

Daily Schedule

Time	Task	Duration
830	Introduction / Controller Briefing	20
850	MACS Training	30
920	MACS Practice	80
1040	Break	10
1050	First Scenario	40
1130	Post Trial Forms	10
1140	Lunch	60
1240	Second Scenario	40
1320	Post Trial Forms	10
1330	Break	10
1340	Third Scenario	40
1420	Post Trial Forms	10
1430	Break	10
1440	Fourth Scenario	40
1520	Post Trial Forms	10
1530	Debrief	60
1630	End	

Metrics

- During run
  - Number of communications and time the pilot and controller spend discussing the encounter
  - Encounter-specific data
    - Losses of well clear
    - Closest point of approach
    - Maneuver type and deviation magnitude
  - Traffic advisory data
    - Time to CPA at which an advisory was issued
    - Predicted CPA that necessitated an advisory
  - Number of “objectionable” simulation artifacts
    - Whether a maneuver/procedure combination was noted
    - Whether a maneuver outside an encounter was noted

Metrics (cont.)

- Post run
  - Workload and traffic complexity
  - Acceptability of aircraft flows, maneuvers
  - Selection of specific objectionable simulation “artifacts”
    - For example, which maneuver/procedure combinations were not preferred
    - Which maneuvers outside an encounter were noticed

Test Setup 3 Experiment Summary

Mike Guminsky

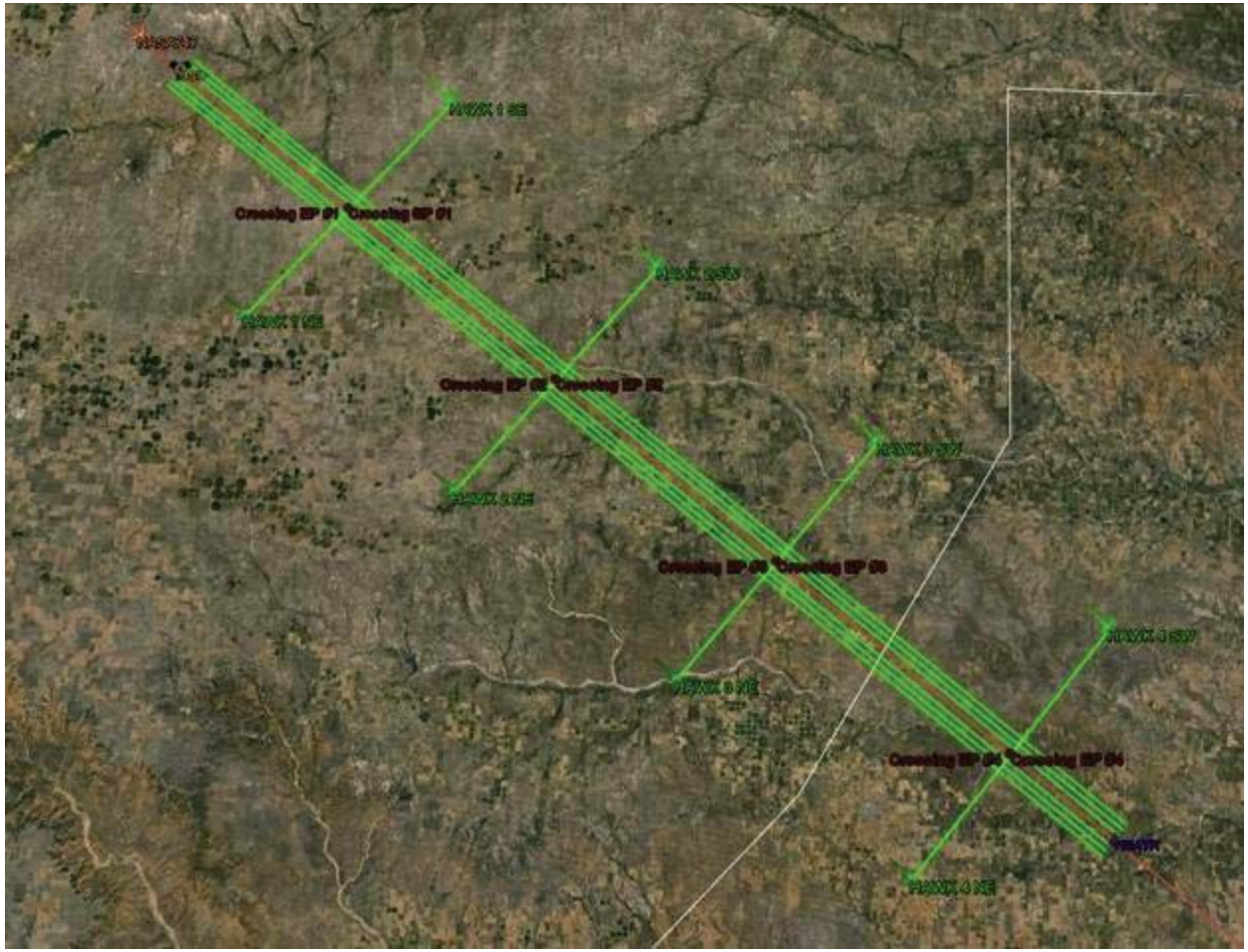
Acceptability of SAA Advisories (Test Setup 3)

- Goal: Collection of performance metrics to determine SAA-TCAS interoperability and address the impact of winds and expected communication delay on the execution of self-separation tasks
- Test Conditions (we'll describe the Sim architecture in later slides):
  - This experiment is broken into two separate data collection efforts
  - TCAS data collection
    - Manned aircraft (virtual) with TCAS installed
      - Canned flight path
    - UAS aircraft
      - Canned flight path (multiple)
    - Flight paths designed to provide specific encounters
    - Variable winds are used to support evaluation of wind uncertainty
      - 5,000 – 17,000 ft
  - Controller data collection
    - UAS pilot in GCS (confederate)
      - Advisories provided by SAA (Stratway+)
    - Virtual manned and unmanned background traffic (confederate)
    - Single sector of interest (controller subject)
      - Retired DFW controllers
    - Staffed adjacent sectors to conduct handoffs (confederate)
    - Scripted scenarios over ZFW airspace
      - Provide encounters
      - Provide workload

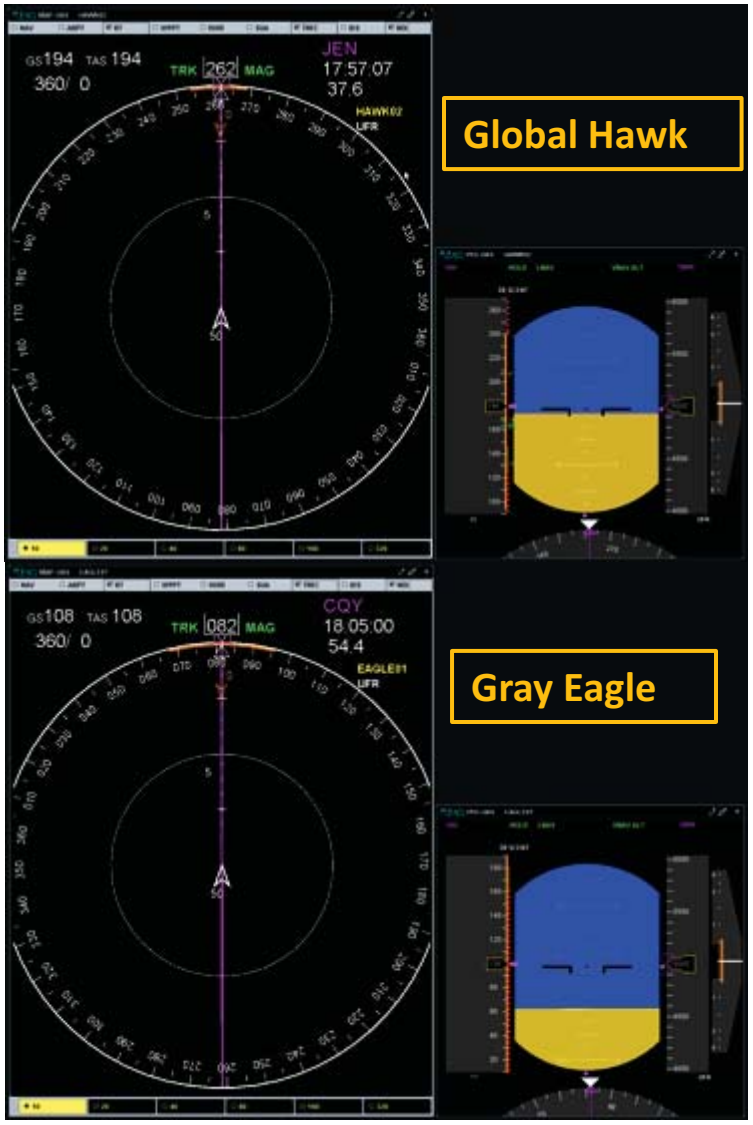
Acceptability of SAA Advisories (Test Setup 3)

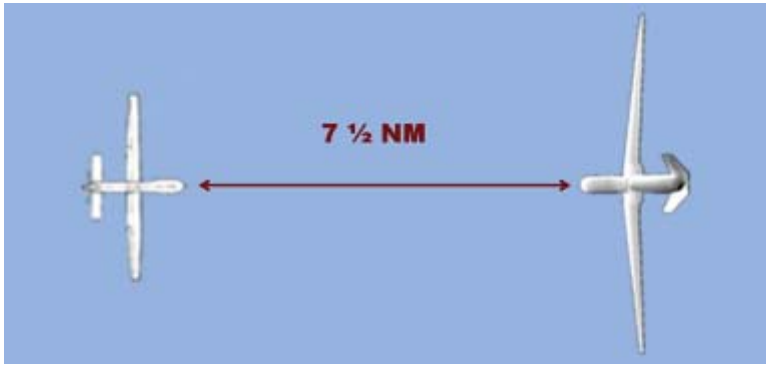
- Test Objectives
  - Evaluate whether the Stratway+ calculated well clear volumes and pilot guidance are sufficient to keep the UA clear of the intruder TCAS II Collision Avoidance Volumes
    - Success: Simulated encounters with the TCAS II equipped aircraft are successful in informing the SS well clear volume definition.
  - Evaluate whether the Stratway+ calculated well clear volumes and pilot guidance are properly accounting for wind direction and velocity to keep the UA well clear of the intruder and the TCAS II Collision Avoidance Volumes
    - Success: Stratway+ SS guidance effectively resolves conflicts with the designated HMD
  - Evaluate whether SAA Self Separation maneuvers are acceptable to air traffic controllers under realistic C2 delays
    - Success: Successfully gather ATC subjective metrics of acceptability with varying communication delays.
  - Evaluate whether realistic C2 delays and varying wind conditions impact SAA design requirements
    - Success: Successfully gather performance data to inform the design of the SS function with varying winds and communication delays.
  - Determine effect of realistic C2 delays on controller perceptions of safe and unsafe conditions
    - Success: Successfully gather ATC subjective metrics of acceptability with regard to flight safety.

TCAS Traffic Example



Self Separation Bands Example





Head-On Encounter:

- Global Hawk (194 kts, 3 deg/sec turn)
- Grey Eagle (108 kts, 1 deg/sec turn)
- Declaration Time = 120 secs
- “TCAS Bands” (20 sec tau, .35 nmi HMD)
- Different Performance = Different Bands

Acceptability of SAA Advisories (Test Setup 3)

- Experiment Review Outcomes
  - No changes to experiment design
  - Proceed with experiment
  - IRB completed
- Test Conduct:
  - TCAS data collection
    - 9-27 June (no subjects)
  - Controller data collection
    - 6 subjects
    - 2 days per Controller subject
    - Each controller subject trained morning of first day
    - 9-10 June, 12-13 June, 23-24 June, 26-27 June, 1-2 July, 8-9 July
    - Participant scripts are have been carried over from UASCAS 1
- Data Analysis
  - TCAS data analysis
    - 28 July to 30 September
  - Controller data collection
    - 28 July to 30 September

I-HITL Data Analysis – TCAS Data Collection Parameters

- VSTALT 5_1 *BLKR 50 TCAS TRAFFIC A/C ALTITUDE [FT] F7.2
- VSTHDG 5_1 *BLKR 50 TCAS TRAFFIC A/C HDG [DEG] F7.2
- VSTALTR 5_1 *BLKR 50 TCAS TRAFFIC A/C ALT RATE [FT/S] F7.2
- VSTSPD 5_1 *BLKR 50 TCAS TRAFFIC A/C SPD [KNTS] F7.2
- VSTLAT 5_1 *BLKR 50 TCAS TRAFFIC A/C LATITUDE [DEG] F7.2
- VSTLON 5_1 *BLKR 50 TCAS TRAFFIC A/C LONGITUDE [DEG] F7.2
- VSTBRG 5_1 *BLKR 50 TCAS A/C BRG REL TO SIM. A/C [DEGS] F7.2
- VSTRNG 5_1 *BLKR 50 TCAS A/C SLANT RNG WRT SIM. A/C [NM] F7.2
- VSTID 5_1 *BLI1 8,50 TCAS TRAFFIC A/C ID [-]
- *
- VSTTRAF 5_1 *BLKR 50 TCAS TRAFFIC ACTIVE FLAG TRUE
- *
- SUTAONLY 5_1 *INT4 2 TCAS in TA only mode, no RAs perm. (P) I9
- SUCCLC 5_1 *LOG1 .F. Aurl warn "CLIMB, CLIMB, CLIMB" (CAE) TRUE
- SUCCLN 5_1 *LOG1 .F. Aurl warn "CLIMB, CLIMB NOW" (CAE) TRUE
- SUCCRC 5_1 *LOG1 .F. Aurl warn "CLIMB, CROSSING CLIMB"(CAE) TRUE
- SUCOFC 5_1 *LOG1 .F. Aurl warn "CLEAR OF CONFLICT" (CAE) TRUE
- SUDCRD 5_1 *LOG1 .F. Aurl warn "DESCEND, CROSSING DESCEND" (CAE) TRUE
- SUDDED 5_1 *LOG1 .F. Aurl warn "DESCEND, DESCEND, DESCEND" (CAE) TRUE
- SUDDEN 5_1 *LOG1 .F. Aurl warn "DESCEND, DESCEND NOW"(CAE) TRUE
- SUICLM 5_1 *LOG1 .F. Aurl warn "INCREASE CLIMB" (CAE) TRUE
- SUIDES 5_1 *LOG1 .F. Aurl warn "INCREASE DESCENT" (CAE) TRUE
- SUMVES 5_1 *LOG1 .F. Aurl warn "MONITOR VERTICAL (CAE) TRUE
- SUMVES2 5_1 *LOG1 .F. Aurl warn SUMVES twice (CAE) TRUE
- SURCLB 5_1 *LOG1 .F. Aurl warn "REDUCE CLIMB" (CAE) TRUE
- SURDES 5_1 *LOG1 .F. Aurl warn "REDUCE DESCENT" (CAE) TRUE
- SUTCSFL 5_1 *LOG1 .F. Aurl warn "TCAS SYSTEM TEST FAIL"(CAE) TRUE
- SUTCSOK 5_1 *LOG1 .F. Aurl warn "TCAS SYSTEM TEST OK" (CAE) TRUE
- SUTTR 5_1 *LOG1 .F. Aurl warn "TRAFFIC, TRAFFIC" (CAE) TRUE
- SUTTR2 5_1 *LOG1 .F. Aurl warn "TRAFFIC, TRAFFIC" (CAE) TRUE

I-HITL Data Analysis – Flight State Data Parameters

MsgFlightState Message:

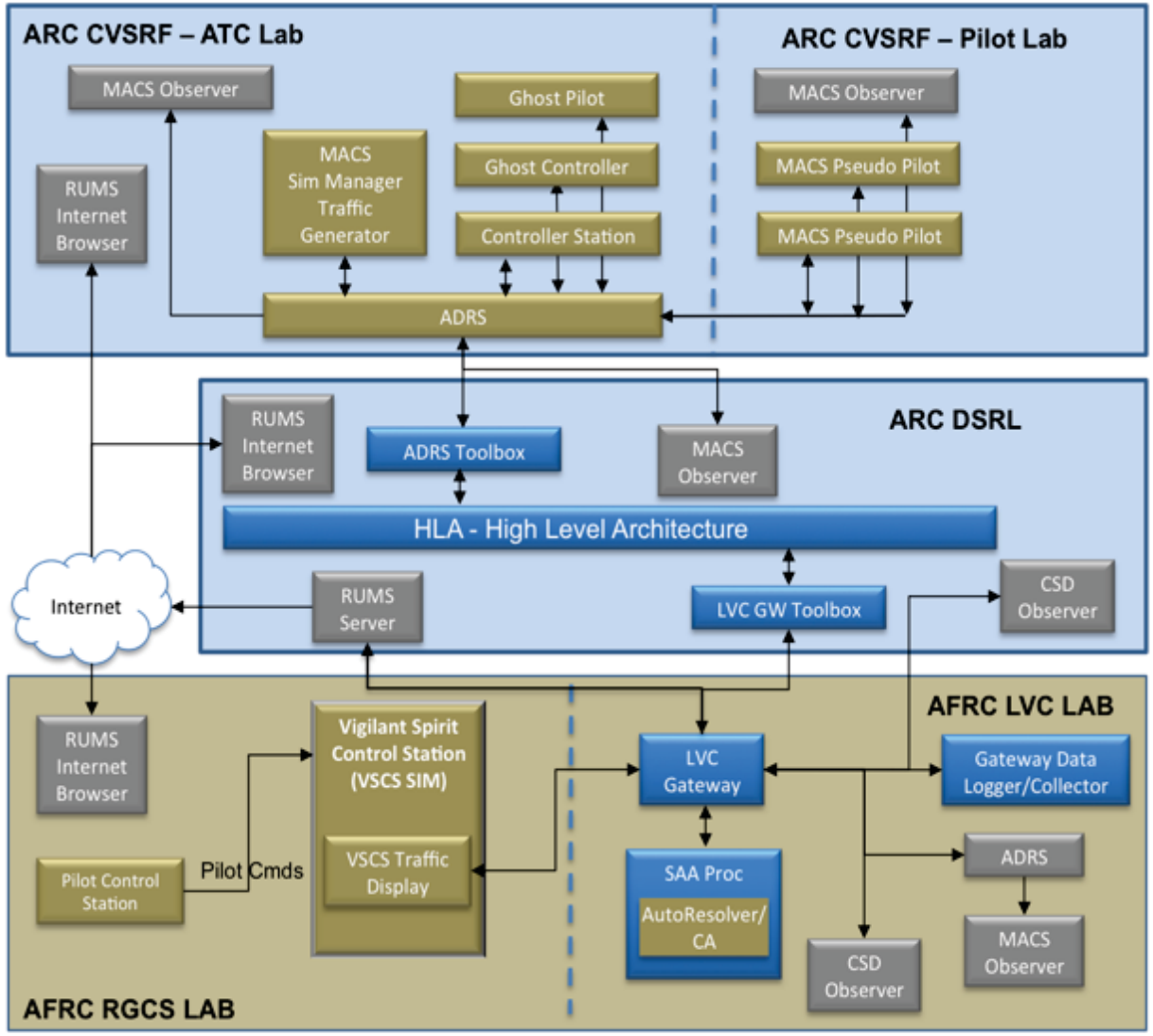
recordedUtcTime, m_acid, m_cid, m_timeCreated,m_timeReceived,
m_latitude,m_longitude,m_pressureAltitude,m_geoAltitude,
m_indicatedAirSpeed,m_mach,m_bankAngle,m_pitchAngle,
m_groundSpeed,m_verticalSpeed,
m_trueHeading,m_magneticVariation,m_trueGroundTrack,m_trueAirSpeed,
m_altitudeTarget,m_headingTarget,m_speedTarget,m_verticalSpeedTarget,
m_equipageFlags,m_modeFlags,m_dlnkFlags,m_configurationFlags,
m_flaps,m_speedBrake,m_windDirection,m_windSpeed,m_outerAirTemperature,
m_mapRangeCaptain,m_mapRangeFo,m_headingBug,
m_vhfFrequency,m_beaconCode,m_geoSectorId,m_atcSectorId,
m_acSectorId,m_atcSectorName

LVC Status and V&V Testing

Jim Murphy

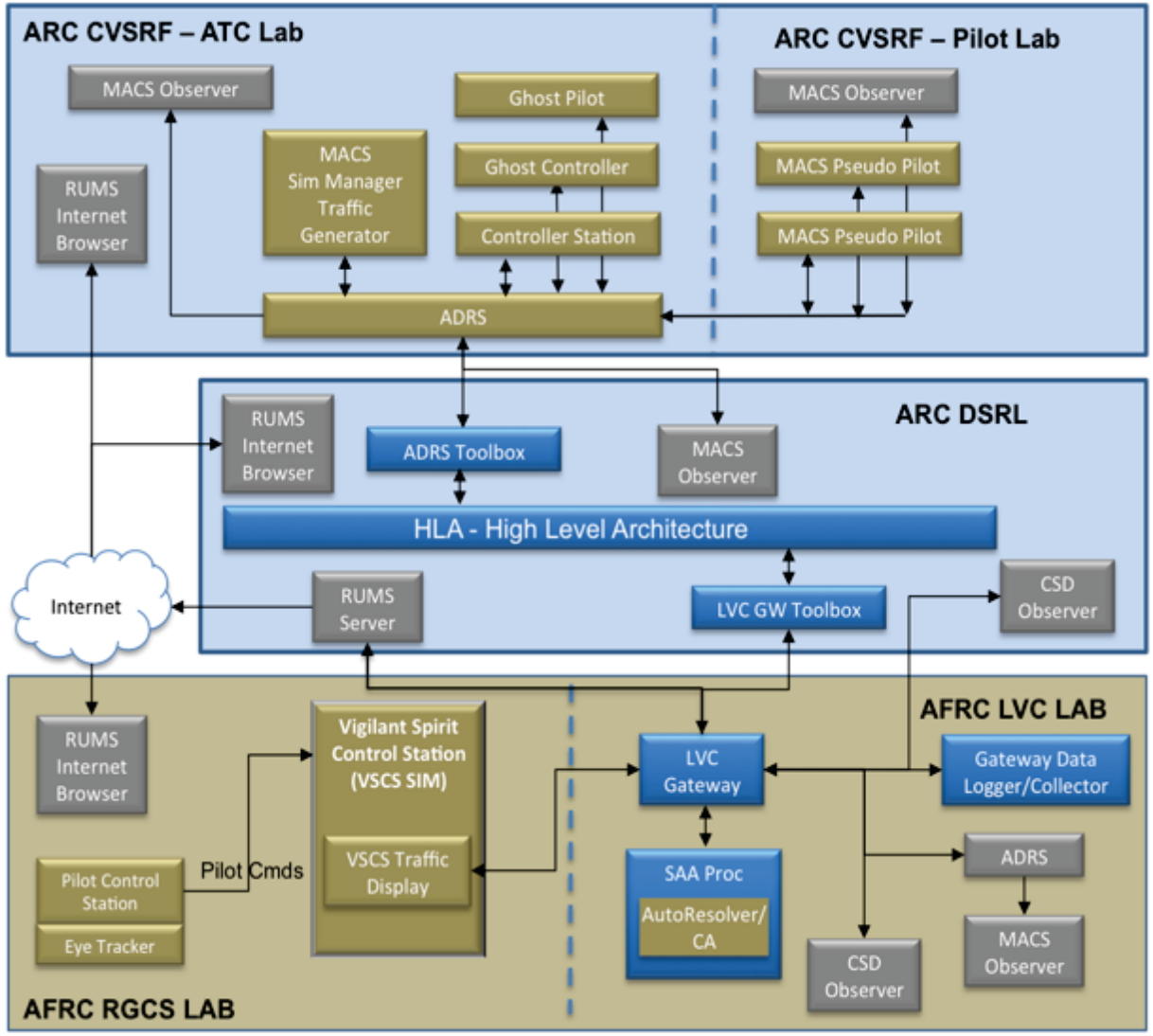
IHITL Test Set-up 1

- Ames
  - Controllers
    - MACS
  - Pseudo Pilots
    - MACS
  - HLA
    - IEEE 1516 standard Pitch portable (RTI)
- Armstrong
  - GCS (UAS pilot)
  - RGCS developed for this project
  - VSCS: AFRL software
    - SAA: AutoResolver/ CA
    - Traffic Display
- Voice Comm:
  - Plexsys: DIS-based



IHITL Test Set-up 2:

- Ames
  - Controllers
    - MACS
  - Pseudo Pilots
    - MACS
  - HLA
    - IEEE 1516 standard Pitch portable (RTI)
- Armstrong
  - GCS (UAS pilot)
  - RGCS developed for this project
  - VSCS: AFRL software
    - SAA: AutoResolver/ CA
    - Traffic Display
  - Eye Tracker
- Voice Comm:
  - Plexsys: DIS-based



IHITL Test Set-up 1 & 2

- V&V Results
  - System Verified May 15-16
  - System Validated May 21-29
    - LVC infrastructure was tested to characterize the distributed message passing latencies
      - Avg Latency = 24 ms
      - Stdev = 14 ms
      - Deemed acceptable by Ames SSI and HSI teams
    - Data from dry run was collected and reviewed by Researchers for completeness
      - Deemed acceptable for IHITL to proceed
    - Traffic scenarios have been reviewed by researchers
      - Deemed acceptable for IHITL data collection
    - IHITL system approved by Ames SSI for use for IHITL (Test Setup 1)
      - Ames HSI waiting for resolution of data drop before approving IHITL system (see Issues slide)
  - Testing Procedures
    - Validation Test: LVC-TPR-08 RevB
    - Delta Software Test Procedure: LVC-TPR-07

IHITL Test Set-up 1 & 2: Validation Matrix

IT&E Research and Technical Objectives				v Flow Down v		Validation								
Req ID	Short Name	Objective from IT&E ORD-01 3/1/2014	Stake-holder	To LVC Req	SS Allocation	T	D	A	I	Description of Validation	Success Criteria	Summary Results	Pass/ Fail	Explanation of any Non-Conformance
ORD-04	Keyboard and Mouse Control for Pilot Station	The RGCS pilot control station incorporates Human Input Devices (keyboard and mouse) for data entry and vehicle control.	HSI	n/a	*RGCS*		x			Keyboard, mouse and keypad are present, integrated with dfrgcs-vscs. Mouse is available for dfrgcs-csd.	All keys pressed are recognized by VSCS software, mouse movement for VSCS and CSD are acceptable to users, no unintended consequences due to key presses, mouse movement moves curser in direction of display location (move mouse off-screen right to move the cursor to the next display located on the right of the current display)	All keys pressed are recognized by VSCS software, mouse movement for VSCS and CSD are acceptable to users, no unintended consequences due to key presses, mouse movement moves curser in direction of display location (move mouse off-screen right to move the cursor to the next display located on the right of the current display)	Pass	
ORD-05	Voice Communication Latency with ATC	Characterize voice communication latencies between the RGCS pilot and virtual air traffic controllers (record and timestamp).	HSI	LVC-16	*RGCS*			x		Manufacturer-provided system latency	Estimated latency falls within researcher criteria.	Researchers have accepted estimate latency.	Pass	
ORD-07	RGCS Human Factors	Develop an operationally representative UAV GCS in support of the Distributed Test Environment for simulation and Flight Test.	IT&E HSI	n/a	*RGCS*		x			LVC Validation Test (LVC-TPR-08) supported by LVC Verifications	System deemed acceptable by all participants. LVC IHITL Verifications complete. 1. The RGCS pilot is able to communicate with virtual ATC at Ames 2. The RGCS pilot is able to control the (simulated) UAV in accordance to the directions given by ATC. 3. The RGCS sends state information to the LVC environment. 4. The RGCS collects and displays other aircraft in the relevant airspace generated within the LVC environment. 5. The RGCS generates the appropriate indications resulting from the SSI algorithm alert messages.	1. Pilot communication with ATC and all other connected participants is clear. PTT handset and foot pedals both work. 2. Pilot commands given to the UAV in all autopilot modes are all accepted and the appropriate response from the UAV (simulation) is observed. 3. The RGCS UAV (Hawk-21) state (position, heading, etc) is observed within the LVC environment. 4. The RGCS air traffic displays on both CSD and within the VS TSD match what is generated and sent through the LVC network. 5. The RGCS warnings and cautions audible and visible alerts are generated by SSI algorithm message inputs to the RGCS.	Pass	
ORD-09	Integrate Vigilant Spirit CS	Integrate relevant subprojects control stations into the RGCS (Vigilant Spirit).	HSI	n/a	*RGCS LVC*		x			LVC Validation Test (LVC-TPR-08) supported by LVC Delta-SW Verification Test (LVC-TPR-07)	Demonstration of VS integration and operation. Delta-SW Verification complete.	Display of air traffic on Vigilant Spirit and CSD has been judged acceptable by HSI and SSI. Vigilant Spirit operates as expected (with state update rates and within the limitations of the dfrgcs-vscs computer specifications). Results from LVC Validation and LVC Delta-SW Verification testing demonstrate	Pass	

IHITL Test Set-up 1 & 2: Validation Matrix

IT&E Research and Technical Objectives				v Flow Down v		Validation								
Req ID	Short Name	Objective from IT&E ORD-01 3/1/2014	Stake-holder	To LVC Req	SS Allocation	T	D	A	I	Description of Validation	Success Criteria	Summary Results	Pass/ Fail	Explanation of any Non-Conformance
ORD-10	Display LVC air traffic on HSI displays	Display air traffic data from the LVC infrastructure on the HSI provided air traffic displays (CSD).	HSI SSI	n/a	*RGCS LVC*		x			LVC Validation Test (LVC-TPR-08) supported by LVC Delta-SW Verification Test (LVC-TPR-07)	Researchers judge system acceptable. Delta-SW Verification complete. CSD displays air traffic data generated by MACS (when used). The VSCS built-in air traffic display displays the air traffic generated by MACS when used.	Display of air traffic on Vigilant Spirit and CSD has been judged acceptable by HSI and SSI. Results from LVC Validation and LVC Delta-SW Verification testing demonstrate performance.	Pass	
ORD-11	IT&E test efficiency and re-configurability	Provide a multi-use RGCS and LVC system allowing for flexible configurations through modular design (hardware / software), multi-function equipment and multi-function software.	IT&E	n/a	*RGCS LVC*		x			LVC Validation Test (LVC-TPR-08) supported by LVC Delta-SW Verification Test (LVC-TPR-07)	Demonstration of a fully integrated and functioning system.	Results from LVC Validation and LVC Delta-SW Verification testing confirm system integration and performance.	Pass	
ORD-12	IT&E Characterization of the Distributed Test Environment for Simulation and Flight Test	Provide the capability in the RGCS and LVC to support the IT&E characterization of the Distributed Test Environment for simulation and flight test.	IT&E	LVC-10,11, 19	*RGCS LVC*			x		Data Analysis from LVC Validation Test (LVC-TPR-08)	Validation Test results judged acceptable from both technical and research perspectives.	Average Latency = 24 ms Standard Deviation = 14 ms Results deemed acceptable by Ames SSI and HSI teams.	Pass	
ORD-13	IT&E Record, Distribute and Manage Data	Record, distribute and manage research data of the Distributed Test Environment for simulation and flight test	IT&E HSI SSI Comm	LVC-1,2,4,5,6,9,12,13,14,16,19,20	*RGCS LVC*		x			Data Management results from LVC Validation Test (LVC-TPR-08)	Effective data management demonstrated. VSCS data files successfully recorded, sent to Ames for post-test analysis	Data exchange capabilities [(AFRC – ARC) and (LaRC –ARC)] in place. Data from LVC Validation tests has been judged acceptable by HSI and SSI.	Pass*	*Further data exchanges planned to exercise the data exchange process during Rehearsal
ORD-14	Integrate UAS in the NAS subproject technologies	Demonstrate the integration of the UAS in the NAS subproject technologies (HSI, SSI, Comm) using simulations and flight test (IHITL, FT3 & FT4).	IT&E HSI SSI Comm	LVC-1,2,4,5,7,16	*RGCS LVC SUA*		x			LVC Validation Test (LVC-TPR-08) supported by LVC Verifications	~~Successful IHITL~~ Vigilant Spirit suite successfully integrated into the RGCS, SSI algorithms successfully integrated into the LVC with resulting displays and audio integrated into RGCS	~~TBD,~~ pending ~~conduct of IHITL~~ VS Suite successfully integrated into RGCS, SSI messages successfully integrated into RGCS (through VS software and CSD)	~~TBD~~ Pass	

IHITL Test Set-up 1 & 2

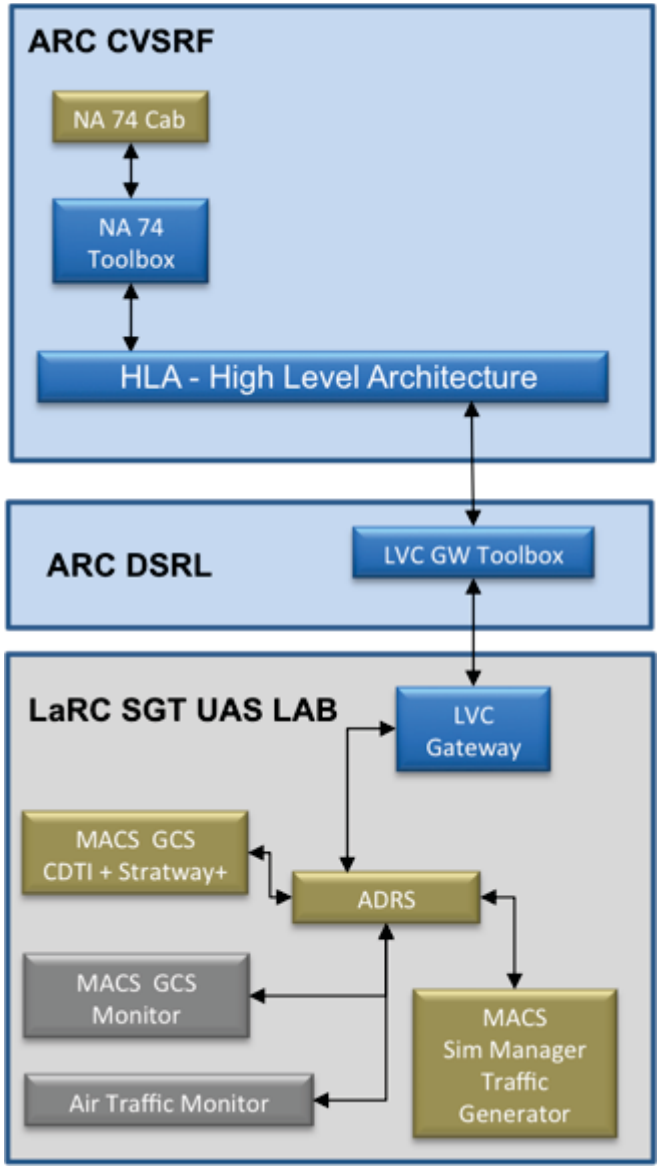
- Issues, Limitations, or Concerns
  - Eye Tracker Software has not yet installed
    - It is only needed for Test setup 2 and is expected to be installed and tested prior to the July data collection time
  - EyeVis has not yet been installed
    - It is only needed for Test setup 2 and is expected to be installed and tested prior to the July data collection time
  - Startup procedures take too long
    - We continue to practice start-up of the system
    - It is critical that this be done in a timely manner to ensure enough time to perform the planned data collection
    - Routine start-ups are 4-5 minutes, since each data collection effort is proceeded by a break, 10 minutes should be sufficient for IHITL
  - Network Latencies
    - During testing on 27-28 May data drop and large latencies were observed
    - These are under investigation
  - Automated data archive not fully tested

IHITL Test Set-up 1 & 2

- Contingency Planning
  - Eye Tracker Software has not yet installed
    - Forfeit eye tracking data collection
  - EyeVis has not yet been installed
    - Install Camtasia as backup
  - Network Latencies
    - Possible software patch
      - Add message header flag to more easily re-sync after lost data packet
      - Does not solve problem, but mitigates its impact
    - Delay Test Setup 2 for two weeks
      - Provides opportunity to test and debug
    - Run GCS out of Ames FDDRL or DSRL
      - This is not desired since distributed testing is an IHITL goal
      - However, may be necessary for Test Setup 2 where the pilot is the subject
    - Delay and move
      - Debug for two weeks, if problem still not resolved, move to FDDRL or DSRL
      - Last Resort
    - Decision Point
      - 6/6/2014 (Friday before Test setup 1 data collection)
  - Automated data archive not fully tested
    - Manual archiving and access tested, scripts to be tested prior to IHITL

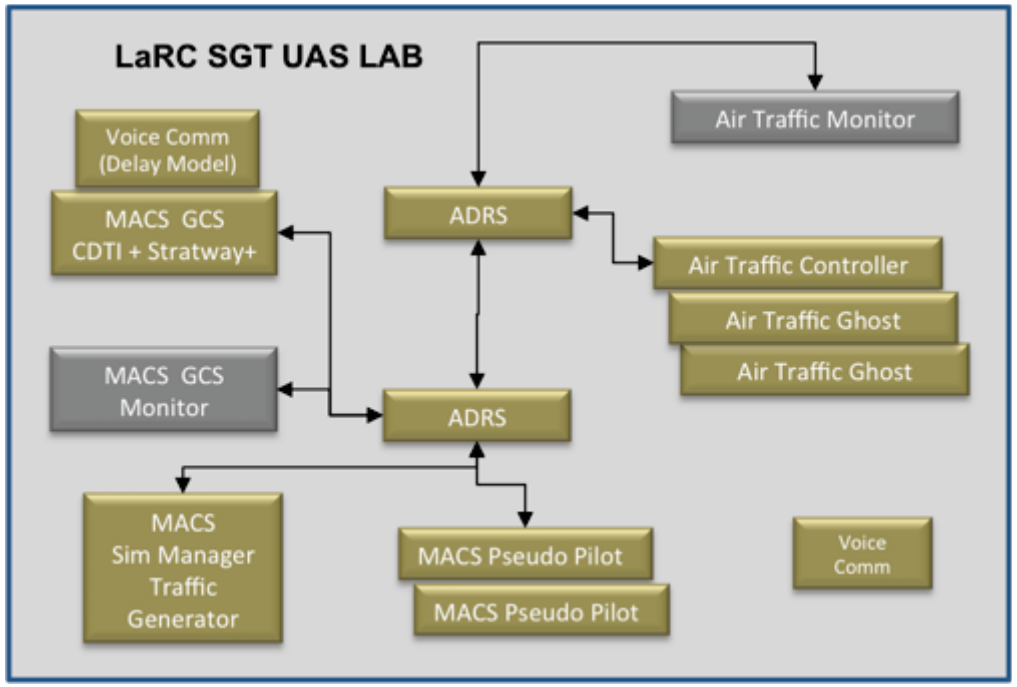
IHITL Test Set-up 3: TCAS Data Collection

- Ames
  - Flight Simulator with TCAS II
    - B747
    - TCAS II version 7.0
  - HLA
    - IEEE 1516 standard Pitch portable (RTI)
- Langley
  - GCS (UAS pilot)
  - Pilot Monitor
    - MACS
  - ATC Monitor
    - MACS
- GCS
  - MACS GCS Engineering Display
- Voice Comm:
  - SimPhonics: DIS-based



IHITL Test Set-up 3: Controller Data Collection

- Langley
  - GCS (UAS pilot)
  - Controllers
    - MACS
  - Pseudo Pilots
    - MACS
  - Pilot Monitor
    - MACS
  - ATC Monitor
    - MACS
- GCS
  - MACS GCS Engineering
- Voice Comm:
  - SimPhonics: DIS-based
    - UAS Comm delay is modeled



IHITL Test Set-up 3

- V&V Results
  - System Verified May 15-16
  - System Validated May 21-29
    - LVC infrastructure was tested to characterize the distributed message passing latencies
      - Avg Latency = 47 ms
      - Stdev = 6 ms
      - Deemed acceptable by Langley SSI team
    - Data from dry run was collected and reviewed by Researchers for completeness
      - Controller subject data collection validated
      - TCAS data validation happening today (based on Wednesday tests)
    - Traffic scenarios have been reviewed by researchers
      - Deemed acceptable for IHITL data collection
    - IHITL system approved by Langley SSI for use for IHITL
  - Testing conducted primarily out of NASA Langley
    - Testing with NASA Ames for TCAS conducted each Wednesday and Friday
  - Need to Board the IHITL versions of the software prior to data collection
- Issues, Limitations, or Concerns
  - Network Latencies
    - The observed data drop between Ames and Armstrong may also impact TCAS data collection
    - This has not been observed, but we are monitoring
  - Automated data archive not fully tested
- Contingency Planning
  - Network Latencies
    - Postpone TCAS data collection until problem is resolved
  - Automated data archive not fully tested
    - Manual archiving and access tested, scripts to be tested prior to IHITL

Test Planning

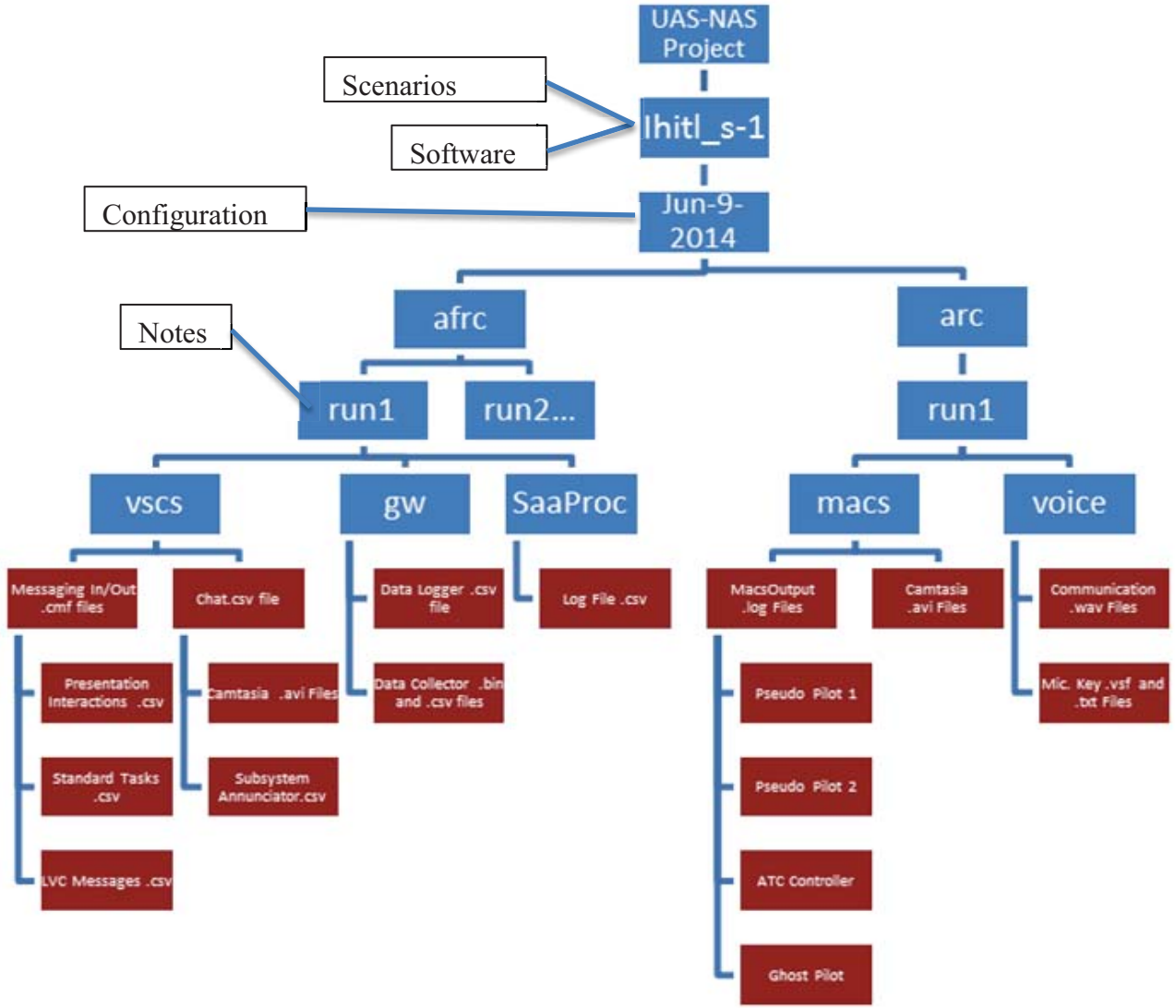
Jim Murphy

IHITL Simulation Planning

- Test Plan
  - Complete and signed (5/27/2014)
  - Includes
    - Description of LVC and simulation components
    - Test Management and Staffing
    - Test Schedule
    - Description of Pre and Post Test Brief
    - Description of Test and Objectives
      - Measurements and data collection
    - Test Procedures
- Data Analysis Plan
  - Complete and signed (5/27/2014)
  - Details of measurements and data collection
  - Describes data archive and distribution plan
    - Each day, all data from each center and test will be sent to Ames for consolidation and archive
    - Archive includes
      - Test procedures run for that day (including any red-lines)
      - Versions of software used
      - Traffic scenarios

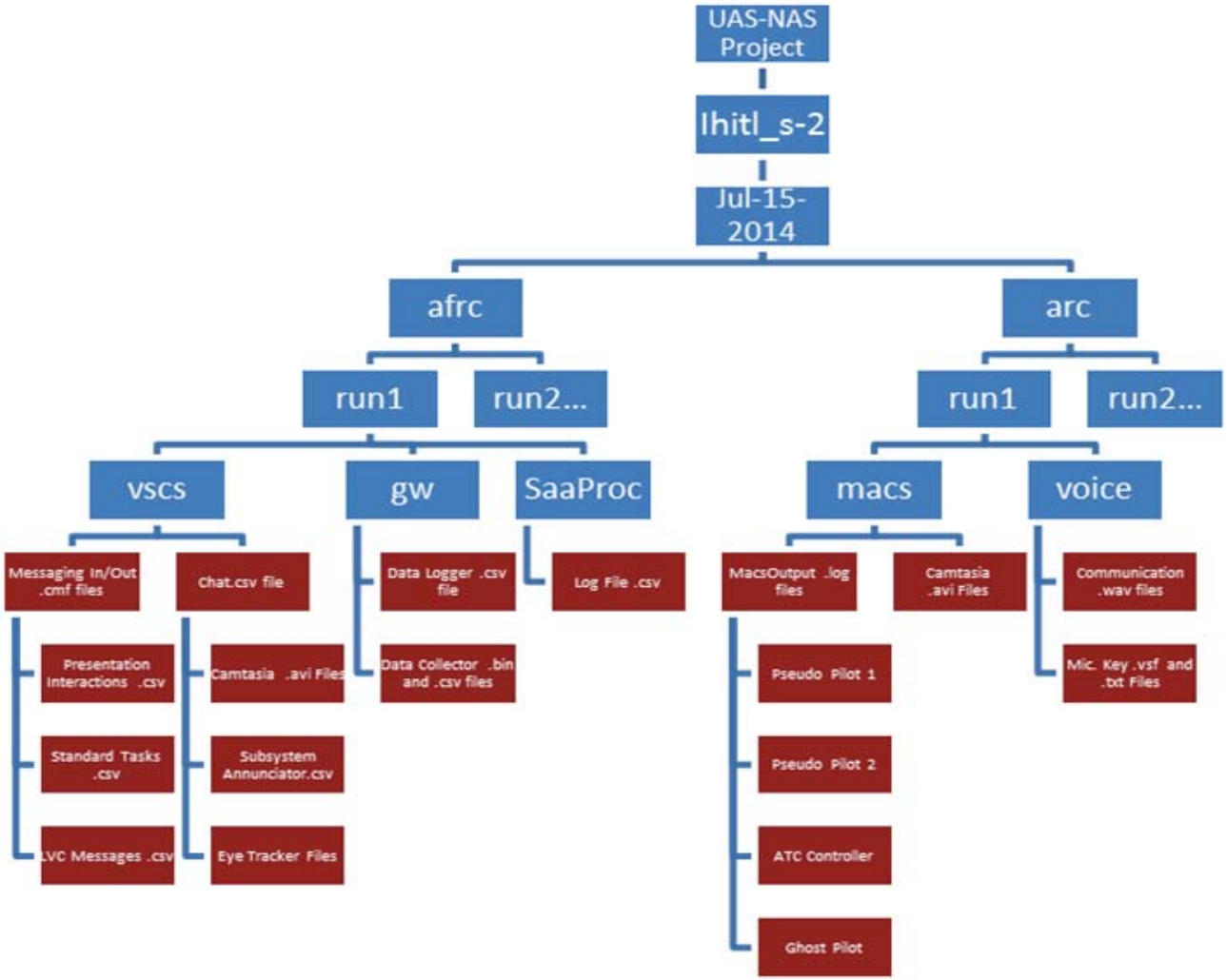
IHITL Simulation Planning

- Data Archiving: Test Setup 1



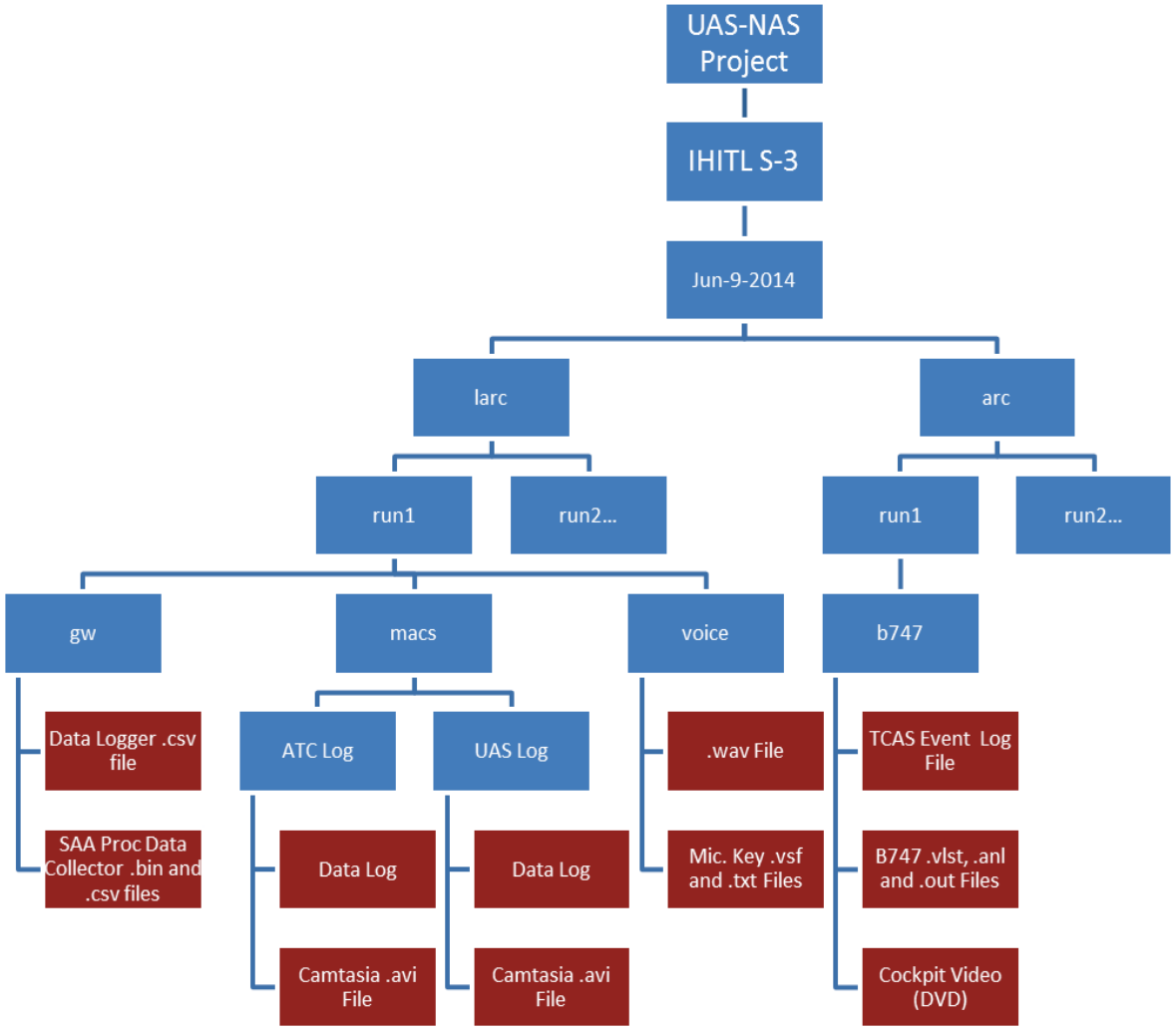
IHITL Simulation Planning

- Data Archiving: Test Setup 2



IHITL Simulation Planning

- Data Archiving: Test Setup 3



IHITL Simulation Planning

- Test Report to be written for FY14 API
  - Includes conduct of test
  - Characterization of system
  - Lessons Learned to inform future simulations and flight tests
    - Lessons Learned to be capture at the daily out-brief and included in Final Test Report

IHITL Simulation Planning

- Key Personnel

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Betty Silva	NASA Ames	betty.silva@nasa.gov	650.604.2117

- Daily Schedule
  - See next charts

IHITL Test Setup 1: Daily Schedule

Time	Task	Duration
830	Introduction / Controller Briefing	20
850	MACS Training	30
920	MACS Practice	80
1040	Break	10
1050	First Scenario	40
1130	Post Trial Forms	10
1140	Lunch	60
1240	Second Scenario	40
1320	Post Trial Forms	10
1330	Break	10
1340	Third Scenario	40
1420	Post Trial Forms	10
1430	Break	10
1440	Fourth Scenario	40
1520	Post Trial Forms	10
1530	Debrief	60
1630	End	

IHITL Test Setup 1: Staffing

			Shakedown/Dress Rehearsal				
Location	*Staffing Requrements*	*Personnel*	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun
Armstrong	LVC Lead Engineer	Jamie Willhite	X	X	X	X	X
	LVC Support	Martin Hoffman	X	X	X	X	X
	RGCS Support	Gayle Patterson	X	X	X	X	X
	Voice Support	Marlin Hoffman	X	X	X	X	X
	UAS Pilot	FRA	X	X	X	X	X
	Data Archiving		X	X	X	X	X
Ames	Researcher	Confesor Santiago	X	X	X	X	X
	Test Conductor	Neil Otto	X	X	X	X	Paul Fast
	DSRL Lead Engineer	Srba Jovic	X	X	X	X	X
	Voice Comm Support	Riva Canton	X	X	X	X	X
	Sim Support	Mohomad	X	X	X	X	X
	Controller	FRA	X	X	X	X	X
	Ghost Controller	Wayne Bridges	X	X	X	X	X
	Ghost Pilot	Jacob Pfeiffer	X	X	X	X	X
	Pseudo Pilot 1 (Confederate)	FRA	X	X	X	X	X
	Pseudo Pilot 2 (Confederate)	FRA	X	X	X	X	X
	Pseudo Pilot 3 (Confederate)	FRA	X	X	X	X	X
	Pseudo Pilot Observer	Sabrina?	X	X	X	X	X
	Data Archiving	Dave Brown	X	X	X	X	X

IHITL Test Setup 1: Staffing

			Data Collection														
Location	*Staffing Requirements*		9-Jun	10-Jun	11-Jun	12-Jun	13-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun
Armstrong	LVC Lead Engineer	Jamie Willhite	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	LVC Support	Martin Hoffman	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	RGCS Support	Gayle Patterson	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Voice Support	Marlin Hoffman	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	UAS Pilot	FRA	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Data Archiving		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ames	Researcher	Confesor Santiago	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Test Conductor	Neil Otto	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	DSRL Lead Engineer	Srba Jovic	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Voice Comm Support	Riva Canton	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Sim Support	Mohomad (on call)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Controller	FRA	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Ghost Controller	Wayne Bridges	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Ghost Pilot	Jacob Pfeiffer	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Pseudo Pilot 1 (Confederate)	FRA	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Pseudo Pilot 2 (Confederate)	FRA	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Pseudo Pilot 3 (Confederate)	FRA	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Pseudo Pilot Observer	Sabrina?	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Data Archiving	Dave Brown	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

IHITL Test Setup 2: Daily Schedule

Proposed Schedule

Time	Task	Duration
0800	Introduction / Pilot Briefing	20
0820	VSCS Training	30
0850	VSCS Practice	30
0920	Break	10
0930	Advanced Display Training	20
0950	Advanced Display Practice	20
1010	System Reset	5
1015	Advanced Display Data Collection	40
1055	Post Trial Forms	10
1105	Break	10
1115	Advanced Display Training	10
1125	Advanced Display Practice	20
1145	System Reset	5
1150	Advanced Display Data Collection	40
1230	Post Trial Forms	10
1240	Lunch	60
1340	Advanced Display Training	10
1350	Advanced Display Practice	20
1410	System Reset	5
1415	Advanced Display Data Collection	40
1455	Post Trial Forms	10
1505	Break	10
1515	Advanced Display Training	10
1525	Advanced Display Practice	20
1545	System Reset	5
1550	Advanced Display Data Collection	40
1630	Post Trial Forms	10
1640	Debrief	20
1700	End	

IHITL Test Setup 2: Staffing / Roles & Responsibilities

			Integration Check		Pre-Test/Shakedown		
Location	*Staffing Requirements*	*Personnel*	7-Jul	8-Jul	9-Jul	10-Jul	11-Jul
Armstrong	Researcher	Conrad Rorie	X	X	X	X	Off Day
	LVC Lead Engineer	Jamie Willhite	X	X	X	X	
	LVC Support	Martin Hoffman ?	X	X	X	X	
	RGCS Support	Gayle Patterson	X	X	X	X	
	Voice Support	Martin Hoffman	X	X	X	X	
	UAS Pilot	AFRC Staff Pilot			Dave Fedors	Karl Magnusson	
	Data Archiving		X	X	X	X	
Ames	Researcher	Confesor Santiago	X	X	X	X	
	Test Conductor	Paul Fast	X	X	X	Srba Jovic	
	DSRL Lead Engineer	Srba Jovic	X	X	X	X	
	Voice Comm Support	Riva Canton	X	X	X	X	
	Sim Support	Mohamad	X	X	X	X	
	Controller (Confederate)	FRA	X	X	X	X	
	Ghost Controller	Wayne Bridges	X	X	X	X	
	Ghost Pilot	Jacob Pfeiffer	X	X	X	X	
	Pseudo Pilot 1 (Confederate)	FRA	X	X	X	X	
	Pseudo Pilot 2 (Confederate)	FRA	X	X	X	X	
	Pseudo Pilot 3 (Confederate)	FRA	X	X	X	X	
	Pseudo Pilot Observer	Sabrina?	X	X	X	X	
	Data Archiving	Dave Brown	X	X	X	X	

IHITL Test Setup 2: Staffing / Roles & Responsibilities

			Data Collection									
Location	*Staffing Requirements*		14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	21-Jul	22-Jul	23-Jul	24-Jul	25-Jul
Armstrong	Researcher	Conrad Rorie	X	X	X	X	X	X	X	X	X	X
	LVC Lead Engineer	Jamie Willhite	X	X	X	X	X	X	X	X	X	X
	LVC Support	Martin Hoffman ?	X	X	X	X	X	X	X	X	X	X
	RGCS Support	Gayle Patterson	X	X	X	X	X	X	X	X	X	X
	Voice Support	Martin Hoffman	X	X	X	X	X	X	X	X	X	X
	UAS Pilot	SME (subject)	CA ANG	CA ANG	CA ANG	CA ANG	CA ANG	4th RW	4th RW	4th RW	4th RW	4th RW
	Data Archiving		X	X	X	X	X	X	X	X	X	X
Ames	Researcher	Confesor Santiago	X	X	X	X	X	X	X	X	X	X
	Test Conductor	Neil Otto	X	X	X	X	X	X	X	X	X	X
	DSRL Lead Engineer	Srba Jovic	X	X	X	Jeff H	Jeff H	Jeff H	Jeff H	Jeff H	Jeff H	Jeff H
	Voice Comm Support	Riva Canton	X	X	X	X	X	X	X	X	X	X
	Sim Support	Mohamad (On Call)	X	X	X	X	X	X	X	X	X	X
	Controller (Confederate)	FRA	X	X	X	X	X	X	X	X	X	X
	Ghost Controller	Wayne Bridges	X	X	X	X	X	X	X	X	X	X
	Ghost Pilot	Jacob Pfeiffer	X	X	X	X	X	X	X	X	X	X
	Pseudo Pilot 1 (Confederate)	FRA	X	X	X	X	X	X	X	X	X	X
	Pseudo Pilot 2 (Confederate)	FRA	X	X	X	X	X	X	X	X	X	X
	Pseudo Pilot 3 (Confederate)	FRA	X	X	X	X	X	X	X	X	X	X
	Pseudo Pilot Observer	Sabrina?	X	X	X	X	X	X	X	X	X	X
	Data Archiving	Dave Brown	X	X	X	X	X	X	X	X	X	X

IHITL Test Setup 3: Daily Schedule: TCAS Data Collection

Time (in EDT)	Task	Duration (minutes)
1130	T-0 Test Team Pre-Brief	30
1200	Data collection	180
1500	Debrief	30
1530	End	

IHITL Test Setup 3: Staffing: TCAS Data Collection

Location	*Staffing Requirements*	*Personnel*	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun
Ames	Test Conductor	Ghislain Saillant	X	X	X	X	
	Voice Support	Dan Wilkins/Riva Canton	N/A	N/A	N/A	N/A	
	HLA Support	Jeff Hernandez	X	X	X	X	
	B747 Pilot	SimLabs Staff	N/A	N/A	N/A	N/A	
	Data Archiving	Dave Brown	X	X	X	X	
Langley	Researcher	Maria Consiglio	X	X	X	X	Off
	Test Director	Mike Guminsky	X	X	X	X	
	Test Conductor	Dimitri Tsakpinis	X	X	X	X	
	LVC Support	Dimitri Tsakpinis	X	X	X	X	
	Pilot Monitor	Mike Guminsky	X	X	X	X	
	Controller Monitor	Ray Comstock	X	X	X	X	

Data Collection

Location	*Staffing Requirements*		9-Jun	10-Jun	11-Jun	12-Jun	13-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun
Ames	Test Conductor	Ghislain Saillant	X	X	X	X		X	X	X	X		X	X	X	X	
	Voice Support	Dan Wilkins/Riva Canton	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A		X	X	X	X	
	HLA Support	Jeff Hernandez	X	X	X	X		X	X	X	X		X	X	X	X	
	B747 Pilot	Matt or Gordon	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A		X	X	X	X	
	Data Archiving	Dave Brown	X	X	X	X		X	X	X	X		X	X	X	X	
Langley	Researcher	Maria Consiglio	X	X	X	X	Off	X	X	X	X	Off	X	X	X	X	Off
	Test Director	Mike Guminsky	X	X	X	X		X	X	X	X		X	X	X	X	
	Test Conductor	Dimitri Tsakpinis	X	X	X	X		X	X	X	X		X	X	X	X	
	LVC Support	Dimitri Tsakpinis	X	X	X	X		X	X	X	X		X	X	X	X	
	Pilot Monitor	Mike Guminsky	X	X	X	X		X	X	X	X		X	X	X	X	
	Controller Monitor	Ray Comstock	X	X	X	X		X	X	X	X		X	X	X	X	

IHITL Test Setup 3: Daily Schedule: Controller Data Collection

Time (in EDT)	Task	Duration (minutes)
Day 1	Day 1	Day 1
0800	T-0 Test Team Pre-Brief	30
0830	Introduction / Pilot Briefing	30
0900	Training	90
1030	Data Collection	60
1130	Post Run Evaluations	30
1200	Lunch	60
1300	Setup	30
1330	Data Collection	60
1430	Post Run Evaluations	20
1450	Break	10
1500	Data Collection	60
1600	Post Run Evaluations	30
1630	Debrief	30
1700	End	
Day 2	Day 2	Day 2
0830	T-0 Test Team Pre-Brief	60
0930	Data Collection	60
1030	Post Run Evaluations	20
1050	Break	10
1100	Data Collection	60
1200	Post Run Evaluations	30
1230	Lunch	60
1330	Setup	30
1400	Data Collection	60
1500	Post Run Evaluations	30
1530	Debrief	30
1600	End	

IHITL Test Setup 3: Staffing: Controller Data Collection

			Shakedown/Dress Rehearsal				
Location	*Staffing Requirements*	*Personnel*	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun
Langley	Researcher	Maria Consiglio	Off	X	X	Off	Off
	Test Director	Jim Chamberlain		X	X		
	Test Conductor	Dimitri Tsakpinis		X	X		
	LVC Support	Dimitri Tsakpinis		X	X		
	Pilot Monitor	Jim Chamberlain		X	X		
	Controller Monitor	Ray Comstock		X	X		
	Controller (Subject)	SME		X	X		
	Ghost Controller	SME		X	X		
	Ghost Controller	SME		X	X		
	Pseudo Pilot 1 (Confederate)	SME		X	X		
	Pseudo Pilot 1 (Confederate)	SME		X	X		
	GCS Pilot (subject)	SME		X	X		

			Data Collection														
Location	*Staffing Requirements*		9-Jun	10-Jun	11-Jun	12-Jun	13-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	30-Jun	1-Jul	2-Jul	8-Jul	9-Jul
Langley	Researcher	Maria Consiglio	X	X	Off	X	X	X	X	Off	X	X	X	X	X	X	X
	Test Director	Jim Chamberlain	X	X		X	X	X	X		X	X	X	X	X	X	X
	Test Conductor	Dimitri Tsakpinis	X	X		X	X	X	X		X	X	X	X	X	X	X
	LVC Support	Dimitri Tsakpinis	X	X		X	X	X	X		X	X	X	X	X	X	X
	Pilot Monitor	Jim Chamberlain	X	X		X	X	X	X		X	X	X	X	X	X	X
	Controller Monitor	Ray Comstock	X	X		X	X	X	X		X	X	X	X	X	X	X
	Controller (Subject)	SME	X	X		X	X	X	X		X	X	X	X	X	X	X
	Ghost Controller	SME	X	X		X	X	X	X		X	X	X	X	X	X	X
	Ghost Controller	SME	X	X		X	X	X	X		X	X	X	X	X	X	X
	Pseudo Pilot 1 (Confederate)	SME	X	X		X	X	X	X		X	X	X	X	X	X	X
	Pseudo Pilot 1 (Confederate)	SME	X	X		X	X	X	X		X	X	X	X	X	X	X
	GCS Pilot (subject)	SME	X	X		X	X	X	X		X	X	X	X	X	X	X

IHITL Simulation Planning

- Readiness Status
  - All personnel are under contract
  - Facilities are booked and ready for data collection
  - V&V complete
  - Software loaded and ready
  - Non-subject participants trained
    - Subjects are trained morning of data collection
    - Participant script have been prepared and are ready

Hazard Analysis

Ken Cross

Current Hazard Analysis Status

- Total IT&E Hazard Reports: 19
- Total IHTL-applicable Hazard Reports: 1
  - Detailed on next slide
- All hazard mitigations are complete & verified
  - No “Accepted Risk” hazards

Safety Procedures

- Control Room/Facility Safety Plans:
  - AFRC:
    - IT&E RGCS/LVC Lab Safety Plan
    - IT&E Visitor Safety Checklist / Export Control Notice
    - Aircrew Flight Ops Manual DCP-O-025 (crew rest, etc.)
  - ARC:
    - Ground Control Station Design for UAS in the NAS
      - Oversight by the Institutional Review Board for use of human subjects in research ops (crew rest, etc.)
    - Building Emergency Action Plans N243 & N257
  - LaRC:
    - (on request)

1 IHTL-Applicable Hazard Report

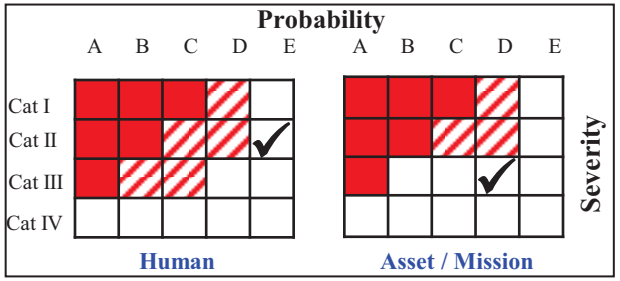
HR #: IT&E-18, Control Room Hazards

Causes	Effects	Mitigations
1. Earthquake 2. Emergency evacuation 3. Exposure to energized equipment 4. Exposure to sharp objects 5. Exposure to hot surfaces 6. Tripping hazards 7. Spilled liquid/food on Control Room hardware system 8. Extended exposure to cold temperatures in the RGCS/LVC Lab 9. Lack of training/written procedures 10. Over exposure to Inergen fire extinguishing agent in enclosed area 11. Fatigue 12. Lack of safety equipment (e.g., fire extinguisher, fire alarm pull station, emergency lighting, etc.) 13. Equipment or building fire	a. Injury to personnel b. Damage to hardware	1) Require periodic independent safety inspections by Dryden Code SH and monthly inspections by team personnel 2) Verify applicable hardware is compliant with earthquake safety requirements 3) Develop and maintain a Control Room Safety Plan that is mandatory reading for all RGCS/LVC Lab operations personnel and includes personnel training requirements 4) Train employees that food/liquid must be kept well clear of electronic equipment and to use spill proof containers to the extent possible 5) Recommend personnel dress accordingly for the colder-than-normal temperatures in the Control Room 6) Require access control to RGCS and LVC Lab 7) Enforce crew rest requirements (per DCP-O-025) for designated "safety critical" personnel 8) Design and build electronic systems to appropriate standards for personnel safety 9) Verify employees have training in and quick access to fire extinguishers, fire alarm pull stations, evacuation route instructions, and other appropriate safety material 10) Verify employees are trained and aware that the Inergen fire extinguishing system poses no threat to personnel when the system is activated and an emergency evacuation is ordered.

Hazard Description

Given that the project is tasked with designing and building a flight research control room consisting of some energized electrical equipment, it is possible that hazards may exist to personnel (project personnel and visitors) and potential damage to high-dollar hardware may be a consideration. This HR applies to both the Research Ground Control Station (RGCS) and the LVC Lab in B4840.

Current Hazard Category



Current Hazard Categories

National Aeronautics and
Space Administration
Armstrong Flight Research Center

Human Safety
Hazard Action Matrix (HAM)
Residual Risk

Injury Severity Classifications	Probability [Pr] Categories				
	A: Expected to occur ($Pr > 10^{-1}$)	B: Probable to occur ($10^{-1} \geq Pr > 10^{-2}$)	C: Likely to occur ($10^{-2} \geq Pr > 10^{-3}$)	D: Unlikely to occur ($10^{-3} \geq Pr > 10^{-6}$)	E: Improbable to occur ($10^{-6} \geq Pr$)
I: Catastrophic				IT&E-06, 07, 10, 11, 12, 16	
II: Critical					18
III: Minor				IT&E-08, 09	
IV: Negligible					

	Requires Center Director approval and may require approval by a higher authority. These hazards are defined as "Accepted Risks."
	Risk acceptance requires Center Director approval. These hazards are defined as "Accepted Risks".
	Risk acceptance requires Project Manager approval.

TEM-001a

Current Hazard Categories

National Aeronautics and
Space Administration
Armstrong Flight Research Center

Loss of Asset/Mission
Hazard Action Matrix (HAM)
Residual Risk

Asset/Mission Severity Classifications	Probability [Pr] Categories				
	A: Expected to occur ($Pr > 10^{-1}$)	B: Probable to occur ($10^{-1} \geq Pr > 10^{-2}$)	C: Likely to occur ($10^{-2} \geq Pr > 10^{-3}$)	D: Unlikely to occur ($10^{-3} \geq Pr > 10^{-6}$)	E: Improbable to occur ($10^{-6} \geq Pr$)
I: Catastrophic				IT&E-06, 07, 10, 11, 12, 16	
II: Critical					
III: Minor			IT&E-01, 02, 13, 14, 17	IT&E-03, 04, 05a, 05b, 08, 15, 18	
IV: Negligible					

	Requires Center Director approval and may require approval by a higher authority. These hazards are defined as "Accepted Risks".
	Risk acceptance requires Center Director approval. These hazards are defined as "Accepted Risks".
	Risk acceptance requires Project/Program Manager approval.

TEM-001b

Public Affairs and Export Control

Duc Tran
Heather Maliska
Vince Schultz

Open CCRs/DRs

DR	CCR	STR	Title	Assigned To	Status	Plan for Closure
13-103	13-232	13-324	Ames MACS Trafic Not Displayed on DFRC MACS	Hernandez	Open	Paperwork cleanup – Will close out of board.
	14-237	14-327	Build/Install New SAA Process Host Comps	Code ME	Open	This has been completed, paperwork needs cleaning up. – Will close out of board.
	14-253	14-335	Install Plexcomm S/W on RGCS	Hoffman	Open	Tested on all but Mission Director Station (not required for IHITL). Final testing to be conducted 5/30, but not necessary for IHITL.
	14-255	14-336	Install Plexcomm S/W on LVC	Hoffman	Open	Tested on all but Mission Director Station (not required for IHITL). Final testing to be conducted 5/30, but not necessary for IHITL.
	14-260	14-340	Update Ikhana LVC Messages	Patterson	Open	Not needed for IHITL
	14-269		Install the required PLEXComm software on LVC Computers in support of the Plexsys Virtual Radio installation	Hoffman	Open	Paperwork cleanup – Will close out of board.
14-109			Vigilant Spirit screen loses display of intruders for brief periods during siumlation runs	Jovic	Open	

Paperwork clean up needed

Open, but not needed for IHITL

Open

CCB needed next week to:

- Baseline DTE-ICD (open item from FDR) – open and close a new CCR
- Baseline LaRC Test Set-up 3
- Close DR-109

Public Affairs

- Planned Tours
  - Ames 16-20 June (during SARP)
    - Non-interference
    - Confesor to give briefing
    - Visits between data collection
- Planned demos
  - Various facilities 28 July – 1 August
    - May need to de-conflict if we need make-up days
    - Hands-on
  - VIP Viewing area included in LVC lab
  - Dryden TV

Export Control (AFRC)

- VSCS Software code used in RGCS treated as ITAR
  - Displays are unrestricted, except for the electronic checklist.
  - Physical and network access should be secure and controlled
  - Access to U.S. Citizens and green card holders only, no foreign nationals
  - Anyone directly interacting with the VSCS software code (with the exception of research participants) should be supporting the UAS-NAS project as per the software agreement
    - Complete the training and return the signed certificate to Gayle Patterson.
      - Kurt
      - Victor
      - Ben
      - Bob Novy
  - Do not transmit VSCS information (code, images, video, spec, etc.) on the internet other than through approved, secure channels.
    - The preferred channels, in order are:
      - VDL (controlled by AFRL)
      - AMRDEC safe site (controlled by the Army)
      - NASA's File Transfer
  - Any information, including pictures, about VSCS that will be transmitted to the public is required to go trough NASA's public release process and vetted by AFRL (via the HSI subproject).
  - Visual demonstrations of the VSCS displays are unrestricted.
    - Hands-on interaction with the VSCS controls are restricted to project approved personnel

Training (AFRC)

- Voice Comm Training
  - Who?
    - Test team on headset
  - What?
    - Use of Plexsys system, comm brevity, and protocol
  - When?
    - 6/2/14
- IHITL Training
  - Who?
    - Those entering the LVC/RGCS (all participants) & visitors
  - What?
    - Briefing on Export Control
    - Control Room Safety Checklist
    - Visitors to sign in upon entry to the RGCS lab
  - When?
    - Test Team: 5/30/14
    - Visitors: to be briefed by escort upon arrival
- Ames/Langley Training
  - Ames test members following existing SimLabs and PT4 protocols
  - Langley test members following existing UASCAS 1 protocols

Summary of Exit Criteria

Mike Brignola

Summary of TRR Exit Criteria

IHITL TRR Success/Exit Criteria	Satisfied (Yes/No)	Notes
1. Adequate test plans are completed and approved for the system under test.		IHITL V&V Plan (5/2014) IHITL Data Analysis Plan (5/2014) IHITL Simulation Test Plan (5/2014)
2. Adequate identification and coordination of required test resources are completed		Test roles slide 36, 91-101
3. Previous component, subsystem, and system test results form a satisfactory basis for proceeding into planned tests.		PE's approval of Distributed Test Environment validation (slide 102): Kim, Murphy, Shively, Santiago, Consiglio, Griner
4. Risk level is identified and accepted by program/competency leadership as required.		Debra Randall's approval to proceed into test
5. Plans to capture any lessons learned from the test program are documented.		Reporting and lessons learned captured by Kim/Murhpy and individual PE's in IHITL daily reports
6. The objectives of the testing have been clearly defined and documented, and the review of all the test plans, as well as the procedures, environment, and configuration of the test item, provides a reasonable expectation that the objectives will be met.		TRR and documentation complete - IHITL CONOPs - IHITL Distributed Test Environment ICD
7. Test cases have been reviewed and analyzed for expected results, and the results are consistent with the test plans and objectives.		HSI Ames Experiment Review slide 17 SSI Ames Experiment Review slide 54 SSI LaRC Experiment Review slide 67
8. Test personnel have received appropriate training in test operation and safety procedures.		Pilot confederate training (complete) Pilot subject training (upon arrival) Controller subject training (upon arrival) Test staff training slide 101, 113 LVC/RGCS Safety Training slide 113

TRR Advice: Don’t take the obvious for granted