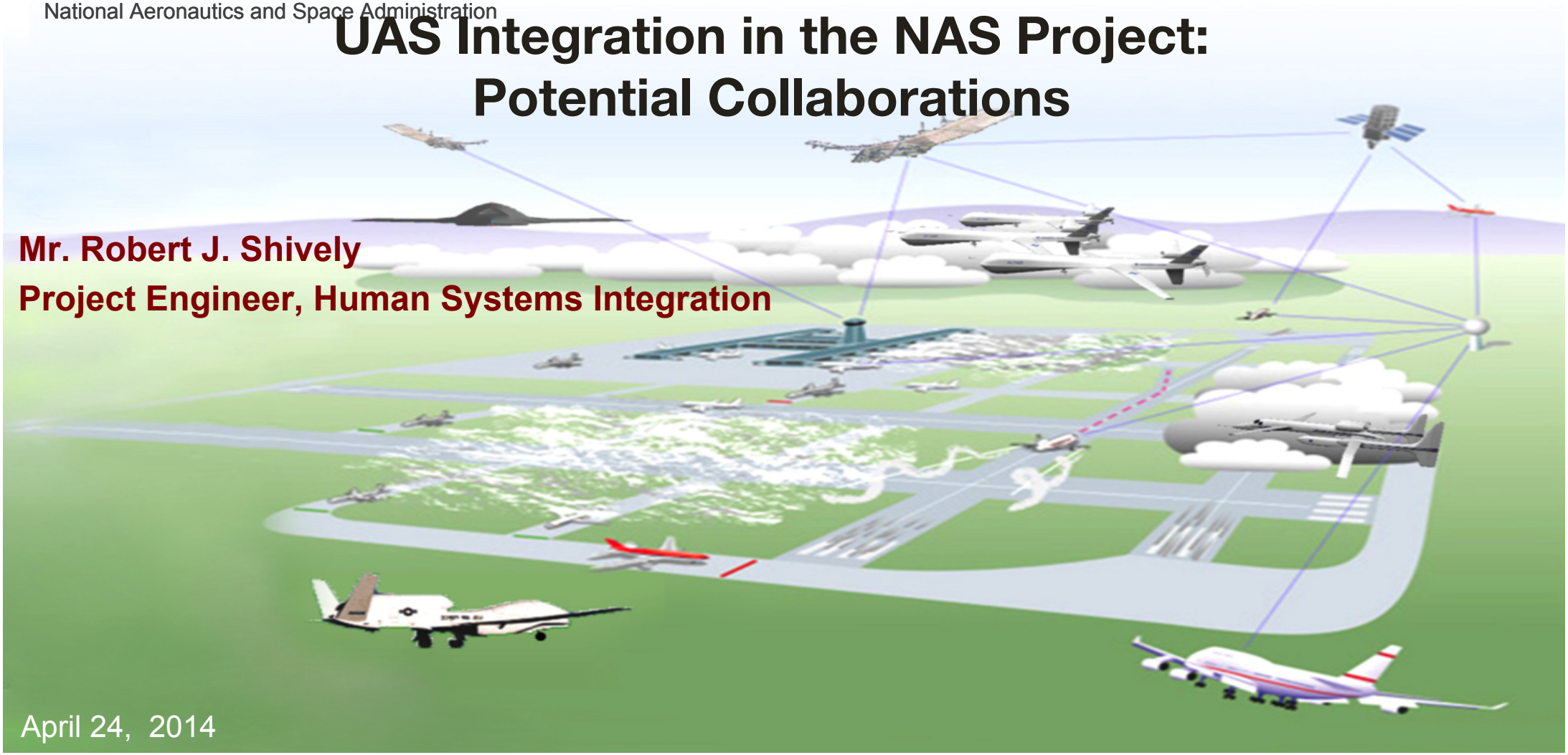

Jay Shivley
NASA

National Aeronautics and Space Administration

UAS Integration in the NAS Project: Potential Collaborations



Mr. Robert J. Shively
Project Engineer, Human Systems Integration

April 24, 2014

Outline

- Relevance of UAS/NAS to this workshop
- Current access – COA's
- FAA legislation
- NASA's UAS Integration into the NAS Project
- RTCA 228
- ABSAA v. GBSAA
- Alaska (Case Study)
- Relevant Projects/Technologies
  - UTM
  - Playbook

Commercial/Public Uses of UAS

- Disaster Relief
- Powerline status
- Agricultural spraying
- Weather observation
- Iceflow observation
- Fishing compliance
- Fish Spotting
- Aerial photography
- Package Delivery
- High Speed WIFI to remote areas

Current UAS Access to the NAS

- Only 2 methods for gaining access currently:
  - Certificates of Waiver or Authorization (COA) for public aircraft
  - Special Airworthiness Certificates – Experimental Category (SAC-EC) for civil aircraft
- Obtaining approval for either is a lengthy, detailed process
  - Can take between 60 and 90 days (depending on complexity of operations) to receive approval
  - Requires extensive pre-planning and coordination with federal and regional authorities
  - Must have well defined procedures for
    - Avoiding traffic (e.g., primary radar system or a chase plane)
    - Managing contingency events (e.g., loss of communications or control link)
  - *FAA has final say over the allowable operations in given airspace*
- **COAs were not designed as a long-term solution** (developed specifically for

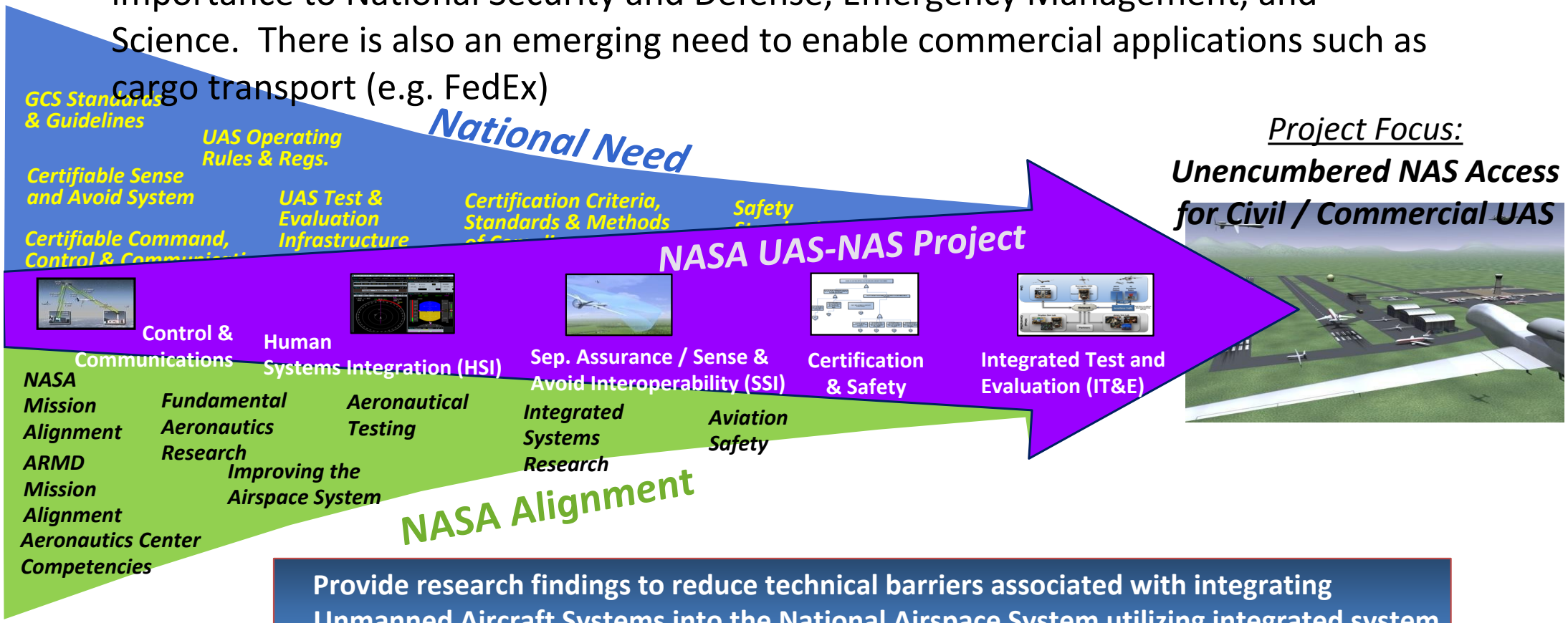
FAA Modernization and Reform Act of 2012

Subtitle B – Unmanned Aircraft Systems

- Calls for the development of a comprehensive plan to "safely accelerate the integration of civil UAS into the NAS"
  - Includes:
    - Defining acceptable standards for operation and certification
    - Development of 'sense and avoid' capabilities
    - Establishment of standards and requirements for the UAS operator
    - Determination of the best methods to ensure safe and route civil UAS operations
  - Plan to be completed by 30 September, 2015
- Goal is for plan to lead to a safe, phased-in approach for civil UAS

Developing the Project

There is an increasing need to fly UAS in the NAS to perform missions of vital importance to National Security and Defense, Emergency Management, and Science. There is also an emerging need to enable commercial applications such as cargo transport (e.g. FedEx)



Project Focus:

Unencumbered NAS Access for Civil / Commercial UAS

Provide research findings to reduce technical barriers associated with integrating Unmanned Aircraft Systems into the National Airspace System utilizing integrated system level tests in a relevant environment

UAS Integration in the NAS Organizational Structure

Host Center

AFRC Director of Programs
Dennis Hines
Deputy Director: Joel Sitz

Program Office

ISRP Program Director
Dr. Ed Waggoner
Deputy PD: Cathy Bahm

ExCom, RTCA Steering Committee, UAS Aviation Rulemaking Committee

External Interfaces
FAA, DoD, RTCA SC-228, Industry, etc.

Project Support

Lead Resource Analyst – Cindy Brandvig - AFRC
Lead Procurement Officer – R. Toberman - AFRC
Lead Scheduler – John Percy – AFRC
Mgmt Support Specialist– Jamie Turner - AFRC
Administrative Support – Giovanna Seli – AFRC
Bus. Sys. Coordinator – Stacey Mulligan – AFRC

Project Office

Project Manager - Laurie Grindle - AFRC
Deputy Project Manager – Robert Sakahara – AFRC
Deputy Project Manager, Integration – Davis Hackenberg - AFRC
Chief Systems Engineer – Debra Randall – AFRC
Staff Systems Engineer – Dan Roth - AFRC

DPMf – AFRC: Heather Maliska
DPMf – ARC: Duc Tran
DPMf – GRC: Amy Jankovsky
DPMf – LaRC: Vince Schultz

Senior Advisor:
Chuck Johnson - AFRC

AFRC ARD
ARC ARD
GRC ARD
LaRC ARD

Subprojects/Technical Challenges (TC)

TC-SAA: SAA Performance Standards
Separation Assurance/Sense and Avoid Interoperability (SSI)
Co-PEs
Eric Mueller - ARC
Marcus Consiglio, LaRC

TC-C2: C2 Performance Standards
Communications
PE
Jim Griner - GRC

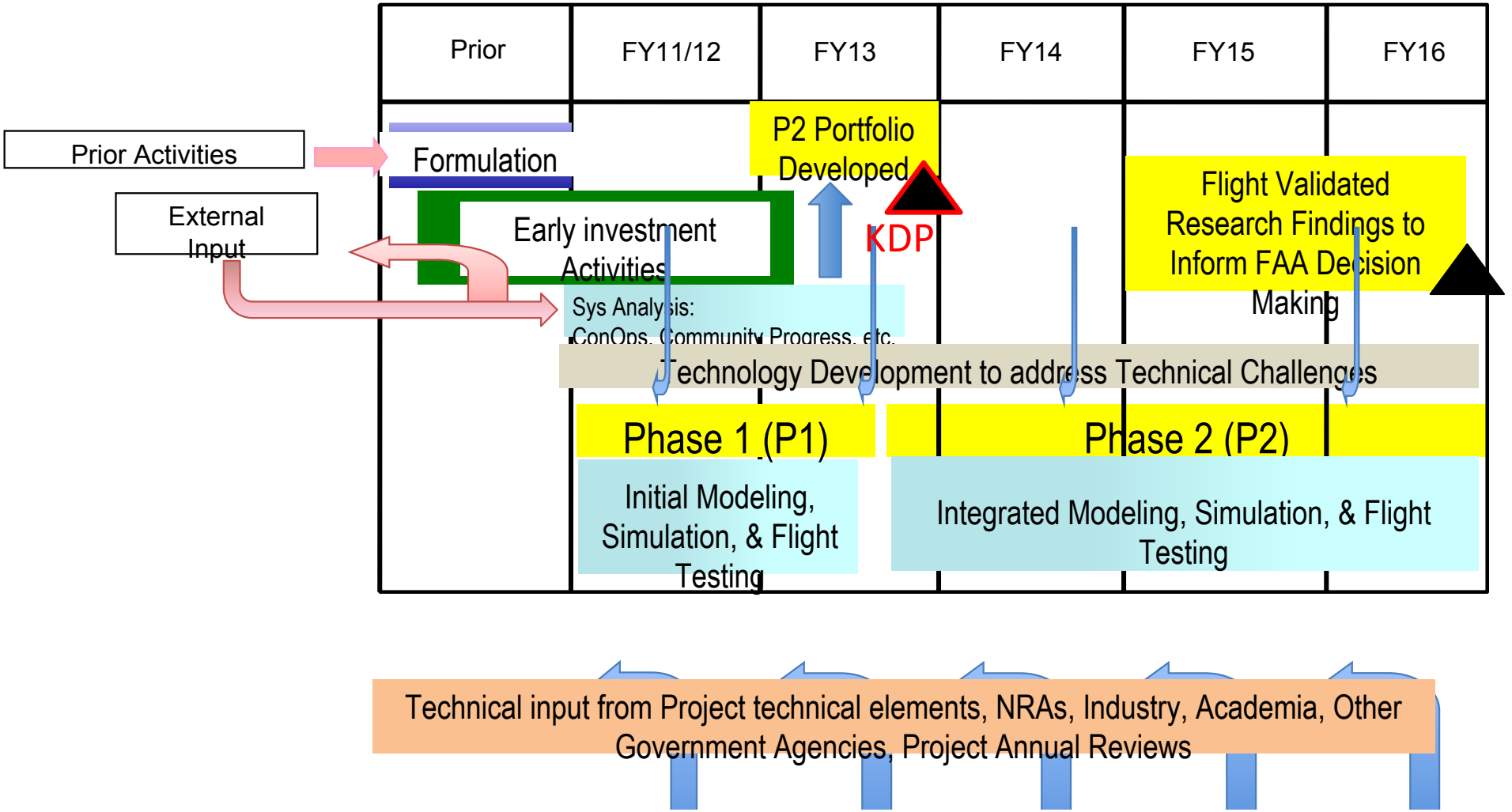
TC-HSI: Human Systems Integration (HSI)
HSI
PE
Jay Shively - ARC

TC-ITE: Integrated Test and Evaluation (IT&E)
IT&E
Co-PEs
Sam Kim - AFRC
Jim Murphy - ARC

Certification
PE
Kelly Hayhurst
LaRC

PE: Project Engineer, DPMf: Deputy Project Manager for

KDP (Phase 1/Phase 2 Transition)



NASA Stakeholders

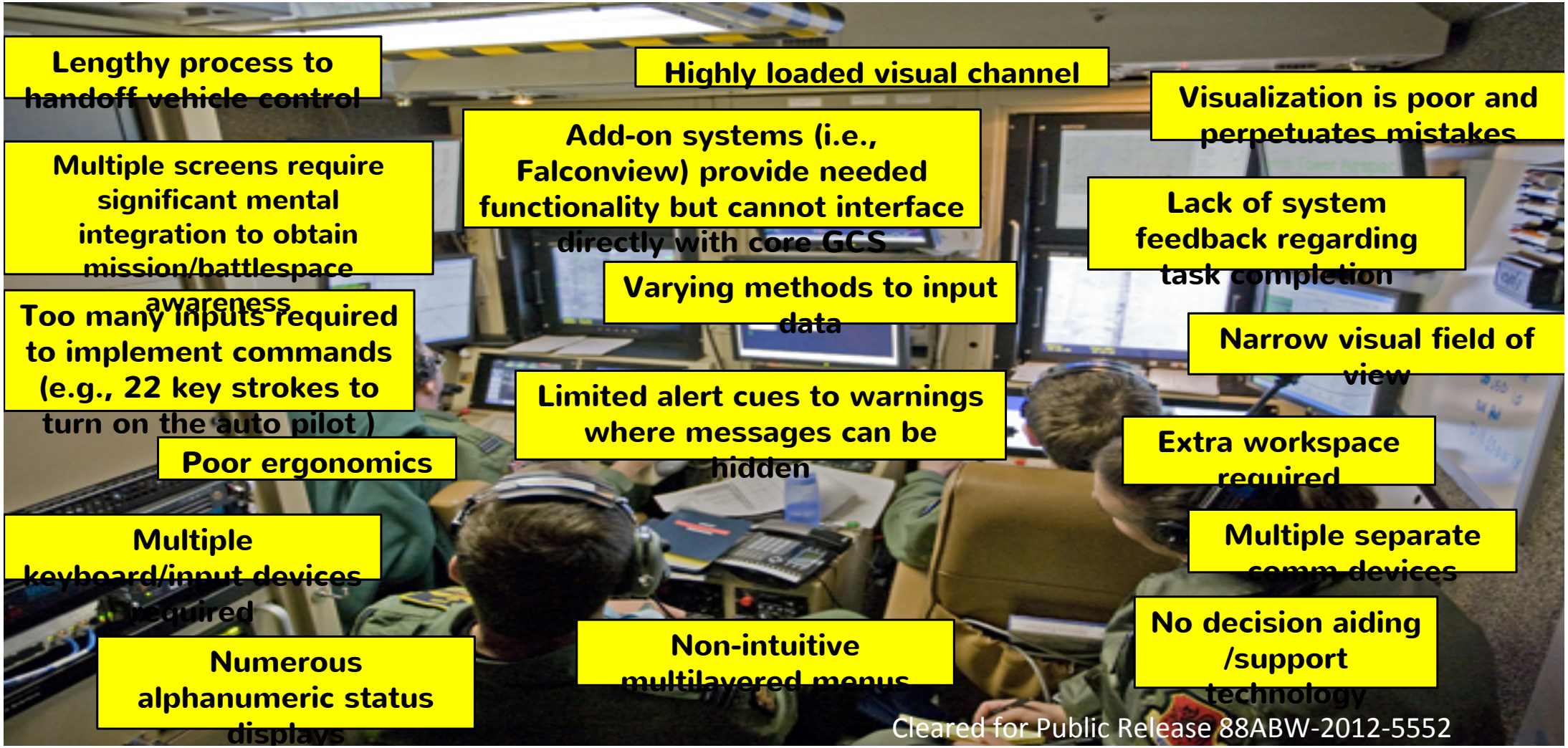
- FAA
- DoD
- Industry
- Scientific Advisory and Research Panel (SARP)
  - OSD, NASA, FAA, DHS
- Radio Technical Commission for Aeronautics (RTCA) - Special Committee 228
  - Used by the FAA
  - Minimum Operational Performance Standards (MOPS)
    - Advisory Circulars
    - FARS

RTCA - Special Committee 228

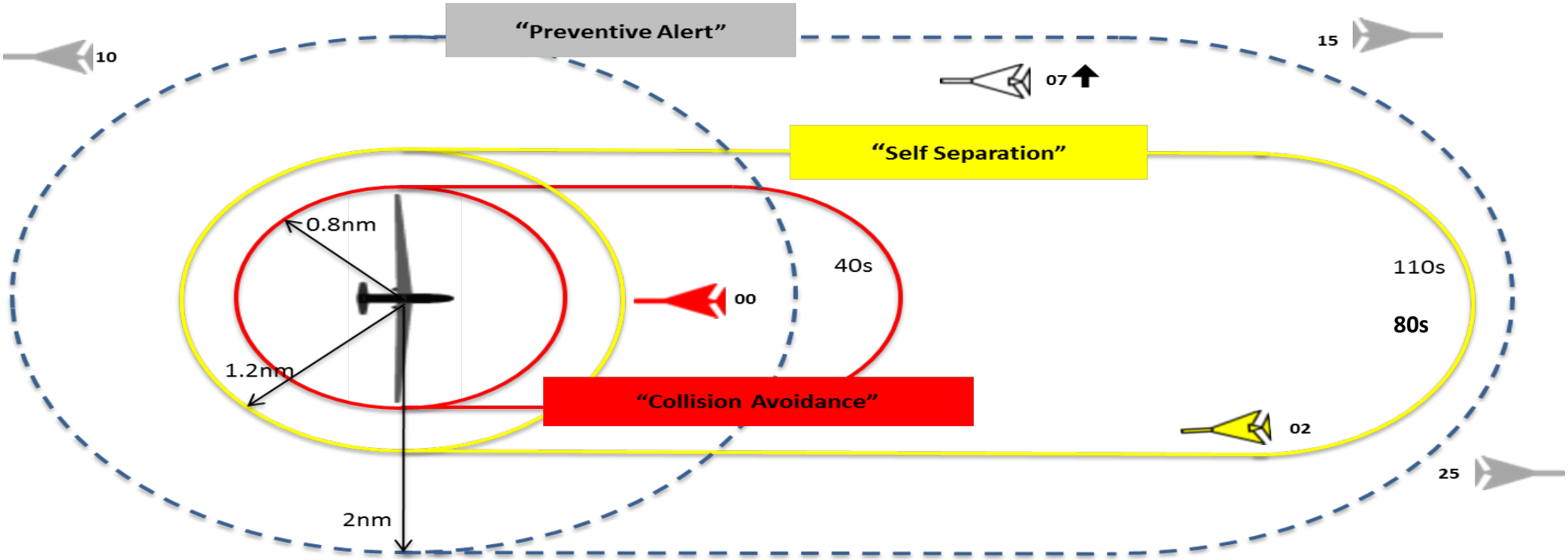
Utilized as a Federal advisory committee, to be the premier Public-Private Partnership venue for developing consensus among diverse and competing interests and provide advice and recommendations on key issues critical to aviation modernization in an increasingly global enterprise.

- SC-228: Minimum Operational Performance Standards for Unmanned Aircraft Systems
  - Command and Control (C2)
    - Secure
      - Anti-tampering/spoofing
    - Reliable
    - Available
  - Detect and Avoid (DAA)
    - Self separation/collision avoidance
    - Algorithms
    - Displays

Current UAV Operator Interface Issues

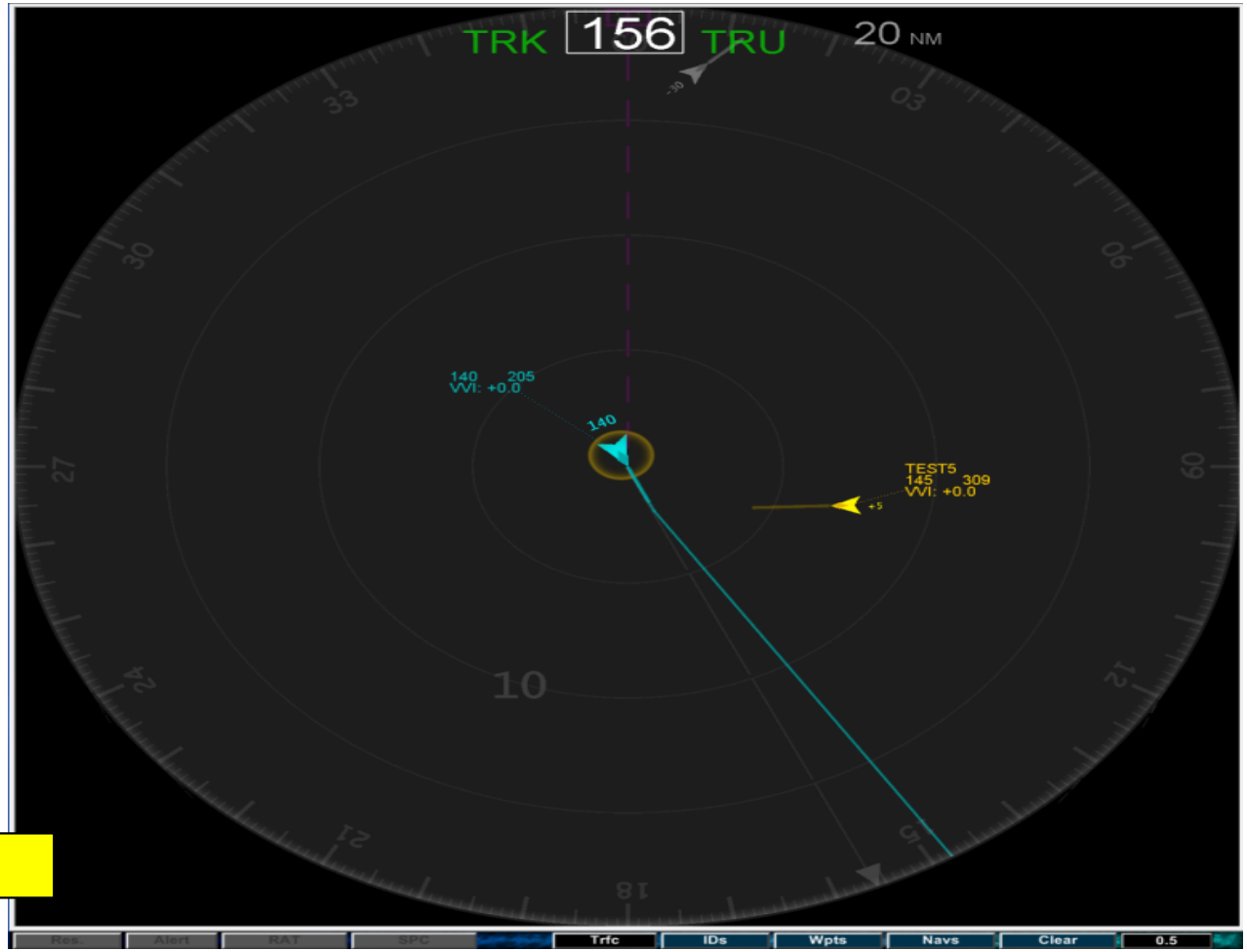


Proposed SS & CA Alerting



Self Separation Alert

- Self Separation Alert - visual and aural alerts are provided
  - Ownship and Intruder data tags will pop up
  - A yellow halo will be displayed around the ownship
  - An aural alert will be given “traffic, traffic”
  - If deemed appropriate, **make maneuver in VSCS**

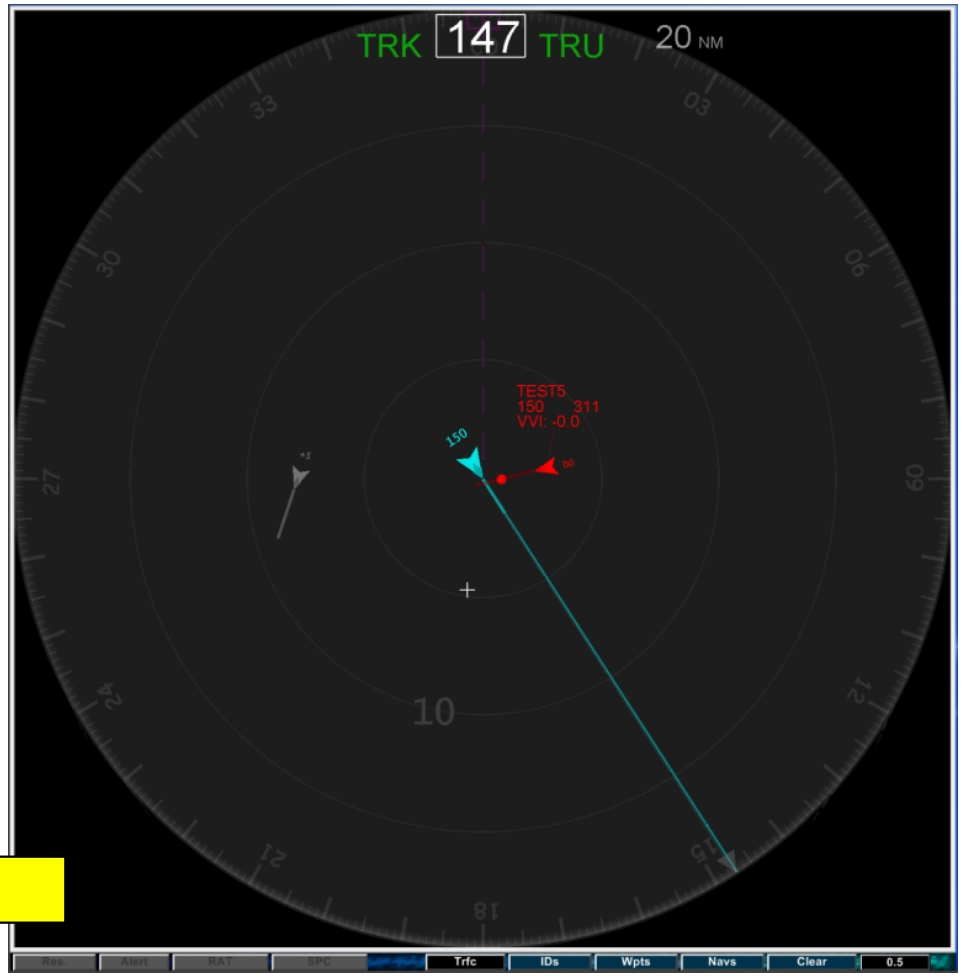


“Traffic, Traffic”

Collision Avoidance Alert

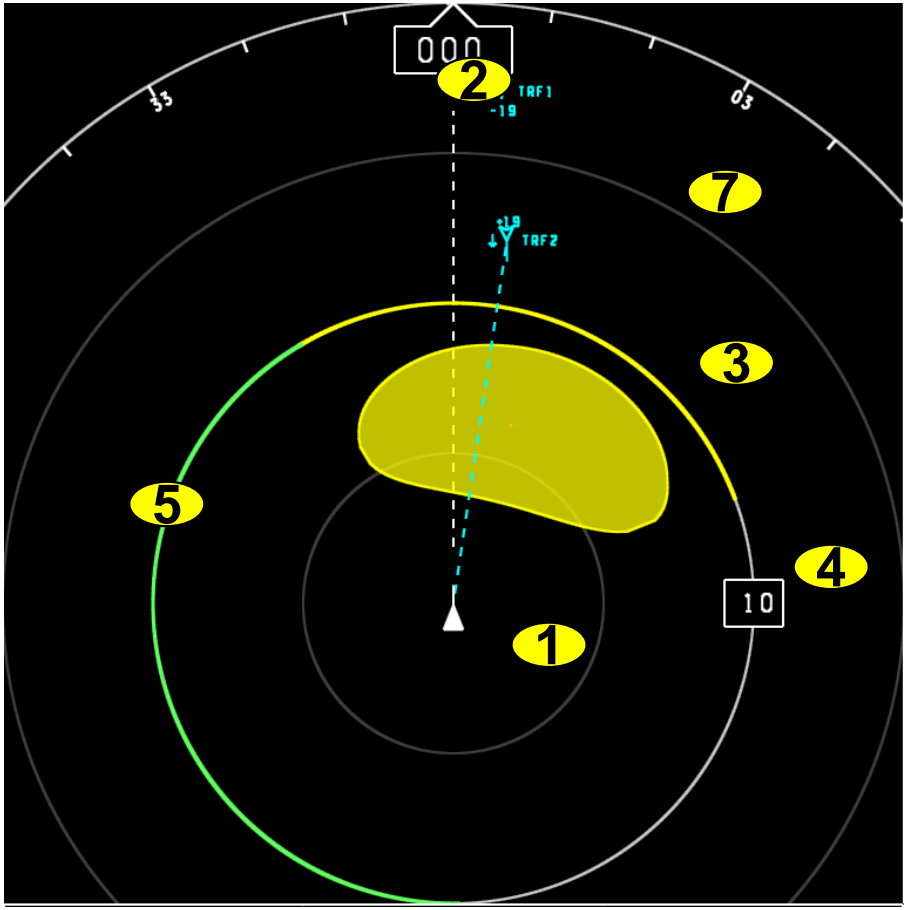
- Collision Avoidance Event- visual and aural alerts are provided
  - Aural alert will provide guidance information (climb/desend/turn)
  - **Move to VSCS and fly the first Collision Avoidance maneuver preser**

“Turn Right”



Top-Down Traffic Display

1. Ownship
2. Heading
3. “No-Go” Heading Band
4. Conflict Probe
5. Green Heading Band
   - Shows recommended maneuver area
6. Range Rings
7. Traffic Symbol
   - Directional (ADS-B)



Some (Human Systems) Lessons Learned

- Lost link
  - Predictability is the key
- Latency
  - Constant latencies are key
- Levels of Automation
  - “cost” of being “on” the loop
- Measured Response
  - UAS comparable to manned
- Detect and Avoid

ABSAA vs. GBSAA

FAA allows Commercial UAS Flight in the Artic

September, 2013

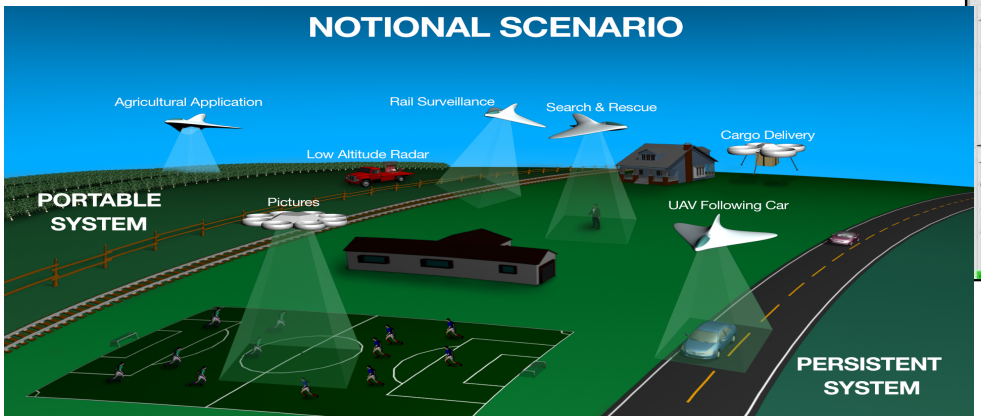
FAA, Insitu, Conoco-Phillips

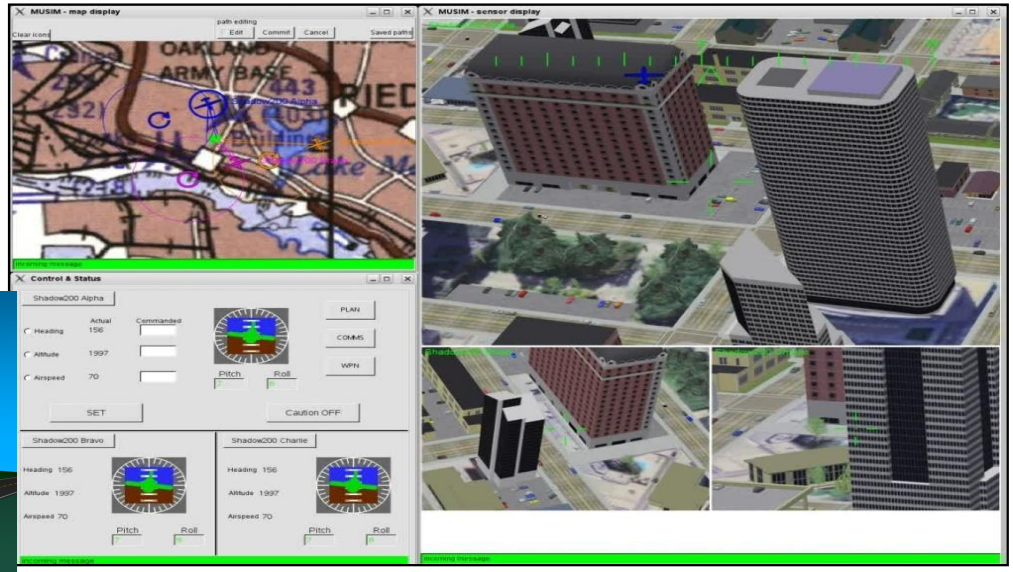
- Four Insitu (Boeing) Scan Eagle UAS
- Marine mammal and ice surveys
- Required for oil drilling
- 3 blocks of international airspace - 24/7
- Below 2000’
- Over low density air, ship and people
- First Civil Certs: Scan Eagle & Puma

Relevant Projects/Technologies

- Unmanned Traffic Management (UTM)

- Playbook





Enabling Civilian Low-Altitude Airspace and Unmanned Aerial System (UAS) Operations

By

Unmanned Aerial System Traffic Management (UTM)

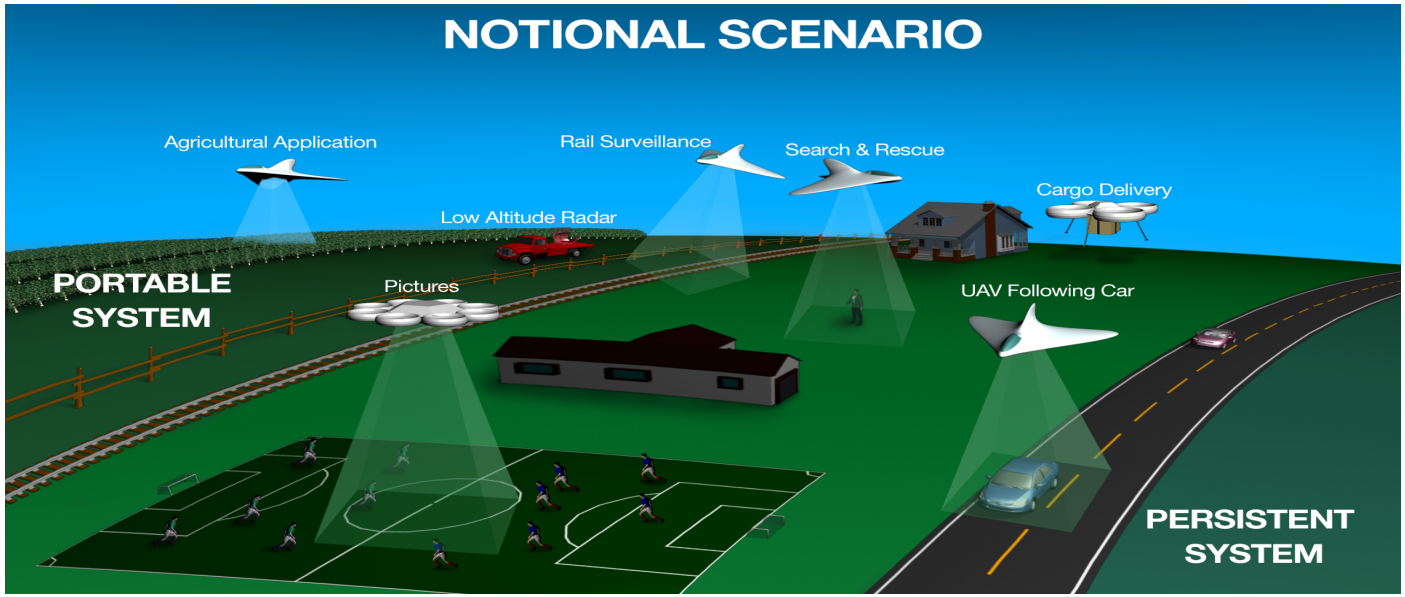
Parimal Kopardekar, Ph.D.

March 17, 2014

Unmanned Aerial Vehicle (UAS) Traffic Management Enabling Low-Altitude Airspace and UAS Operations

MOTIVATION

- Many UAS will operate at lower altitude (Class G, below 2000 Feet)
- There is urgent need for a system for civilian low-altitude airspace and UAS operations
- Stakeholders want to work



CONCEPT OVERVIEW

- UTM System will provide following services
  - Airspace design and geo-fencing
  - Weather integration
  - Congestion management
  - Separation management

NEAR-TERM GOAL

Safely enable low-altitude operations within 5 years

LONG-TERM GOAL

Accommodate increased demand 10-

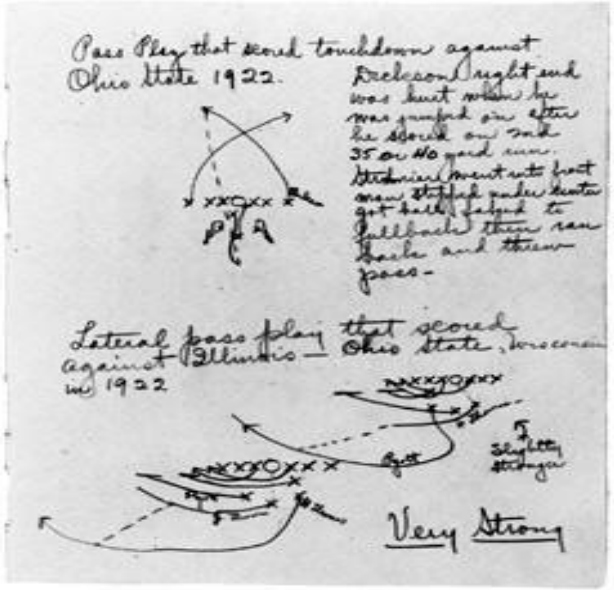
Next Steps

- Obtain authorization to proceed with further development of UTM
- Refine UTM design, architecture, and use cases
- Explore partnership arrangements to engage traditional and non-traditional partners

NEAR-TERM GOAL: Enable low-altitude operations within 5 years

LONG-TERM GOAL: Accommodate increased demand 10-15 years

Delegation Control: Playbook®



A page from Alonzo Stagg's 1927 Playbook

- Delegation: one way humans manage supervisory control with heterogeneous, intelligent assets
- Playbook®: ones means of delegation
- Plays: analogous to football
  - Quick commands – complex actions
- A Play provides a framework
  - References an acceptable range of plan/behavior alternatives
  - Requires shared knowledge of domain Goals, Tasks and Actions
  - Supervisor can further constrain/stipulate

Plays

- DoD
  - Troops in contact (Example)
  - Convoy support
  - Area surveillance

- Civil
  - Disaster relief
  - Law enforcement
  - Fire
  - Ocean/fishing conservation

Example: Troops in Contact Tango

Flight Demonstration 2009

Ft. Ord CA, 23 APR 2009

Goal:

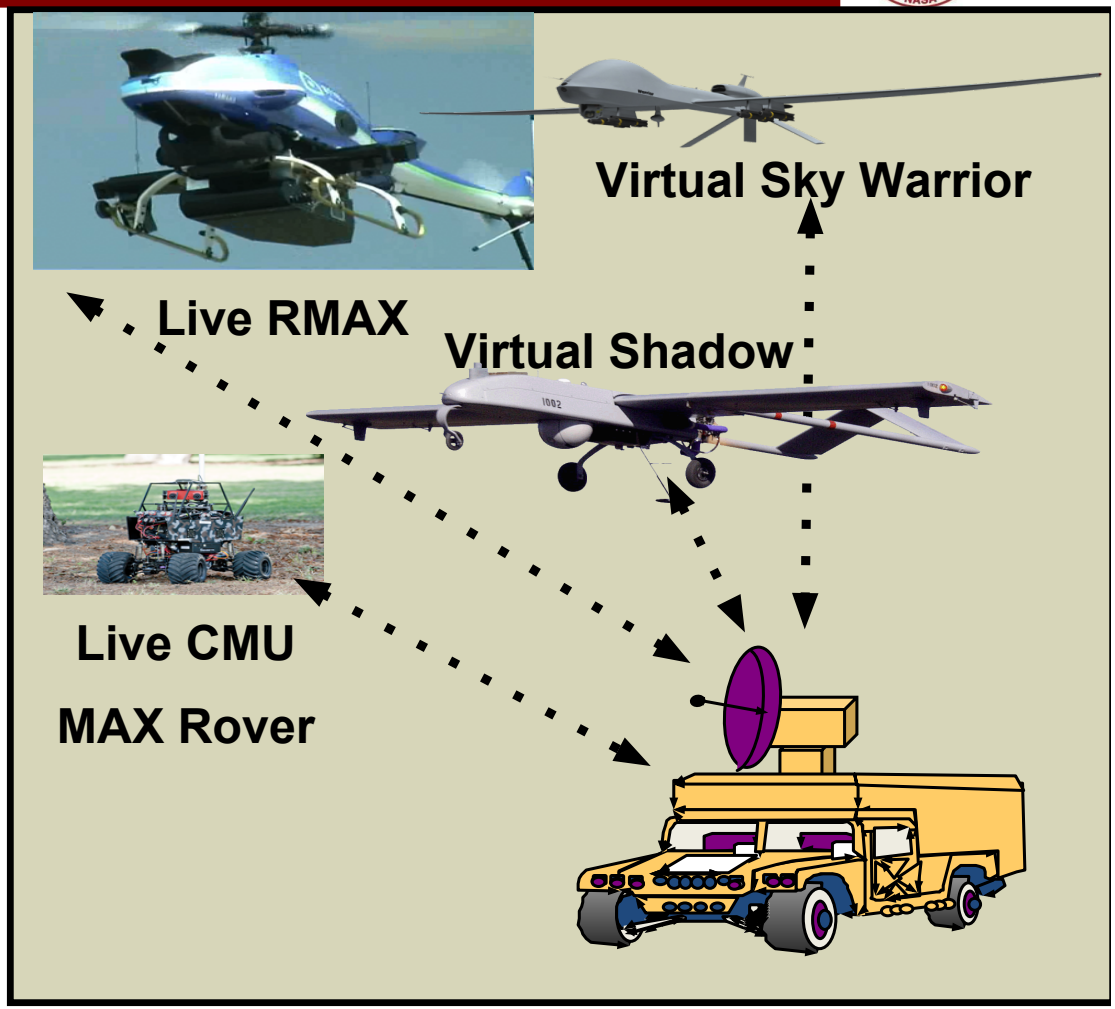
- Demonstrates initial proof of concept of Delegation Control (Playbook) in flight – supervisory control of multiple air/ground assets in MOUT Scenario

Method:

- Live/Virtual Demo – Controlling RMAX, CMU MAX Rover and 2 virtual UAS with Delegation Control
- Voice RGN Control (USAF)

Features:

- Delegation control human-machine interface supports control and monitoring 4 payloads
- Automation Transparency



Flight Demonstration 2011

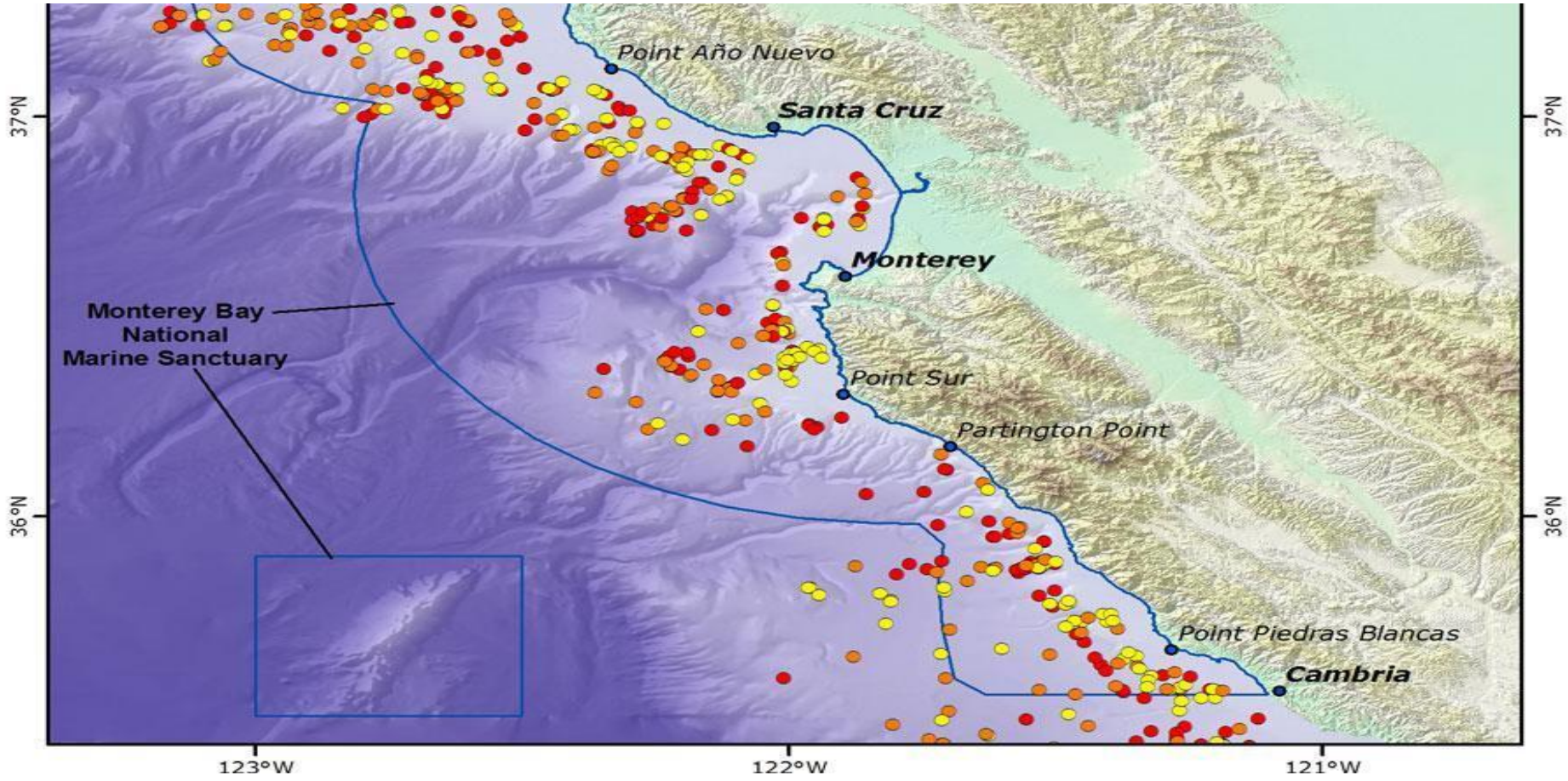
Ft. Hunter-Liggett CA, 19 May 2011

Purpose:

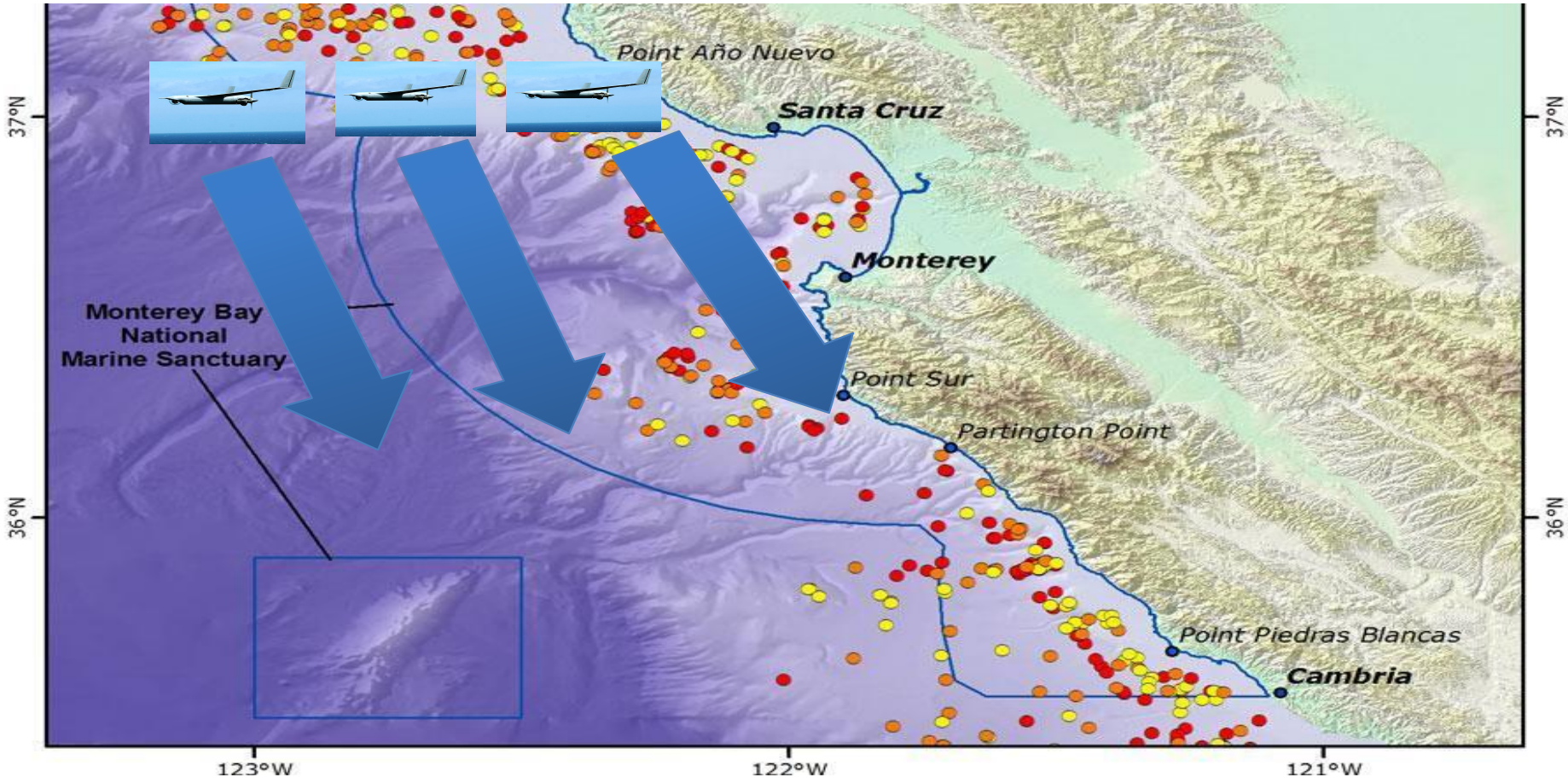
- Build on previous simulations and flight test examining single operator control of multiple heterogeneous ground/air unmanned systems through delegation control employment
  - Operator performance data collection/workload assessments
  - Heterogeneous flight assets: Boeing Scan Eagle and Yamaha RMAX; two virtual UAS
  - Testing in operationally relevant mission scenarios
  - Multi-sensor cross-cue in support of both targeting and convoy support
- Army AFDD/Boeing CRADA

Key Objective:

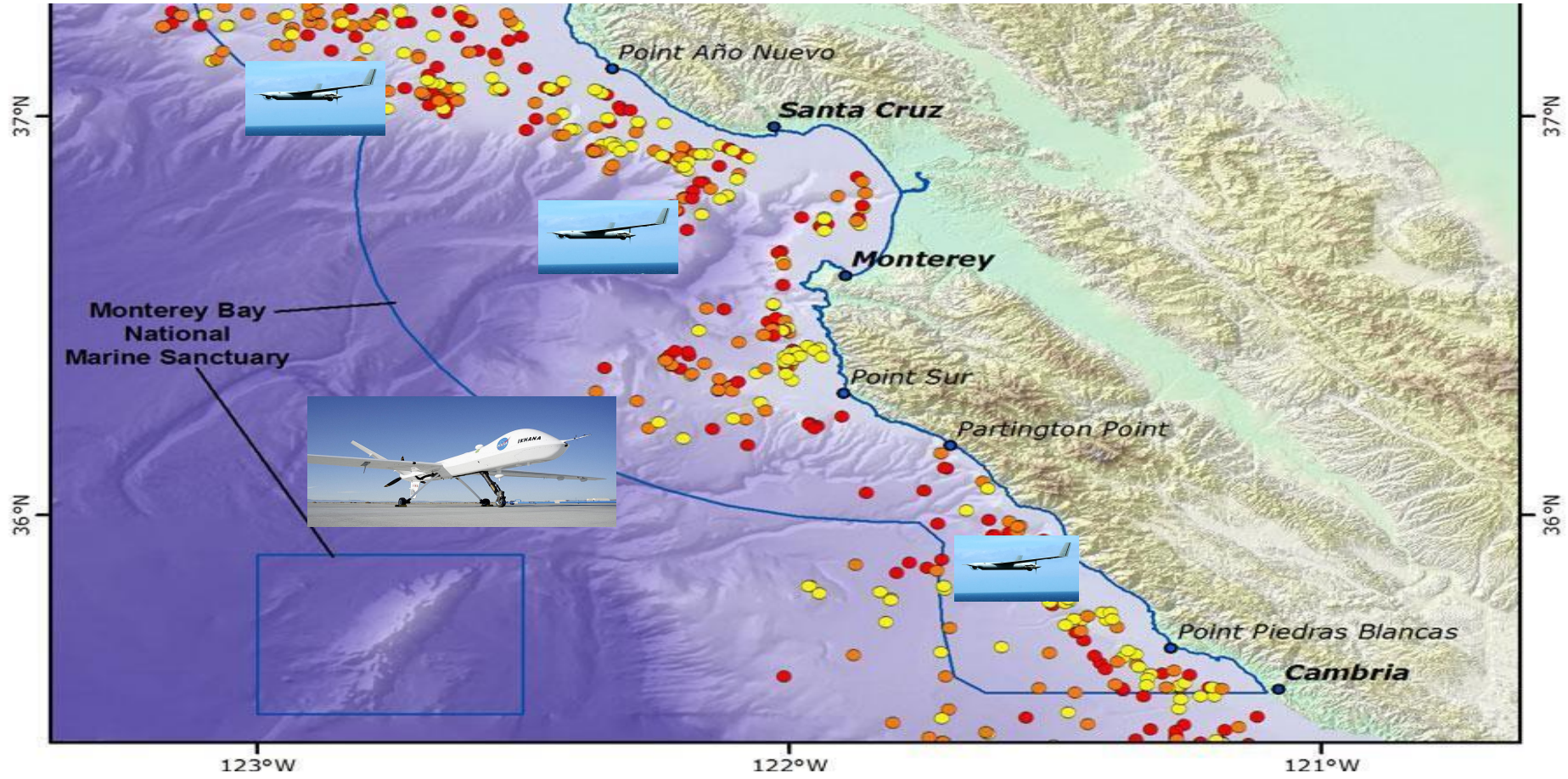
Monterey Bay Fish Density



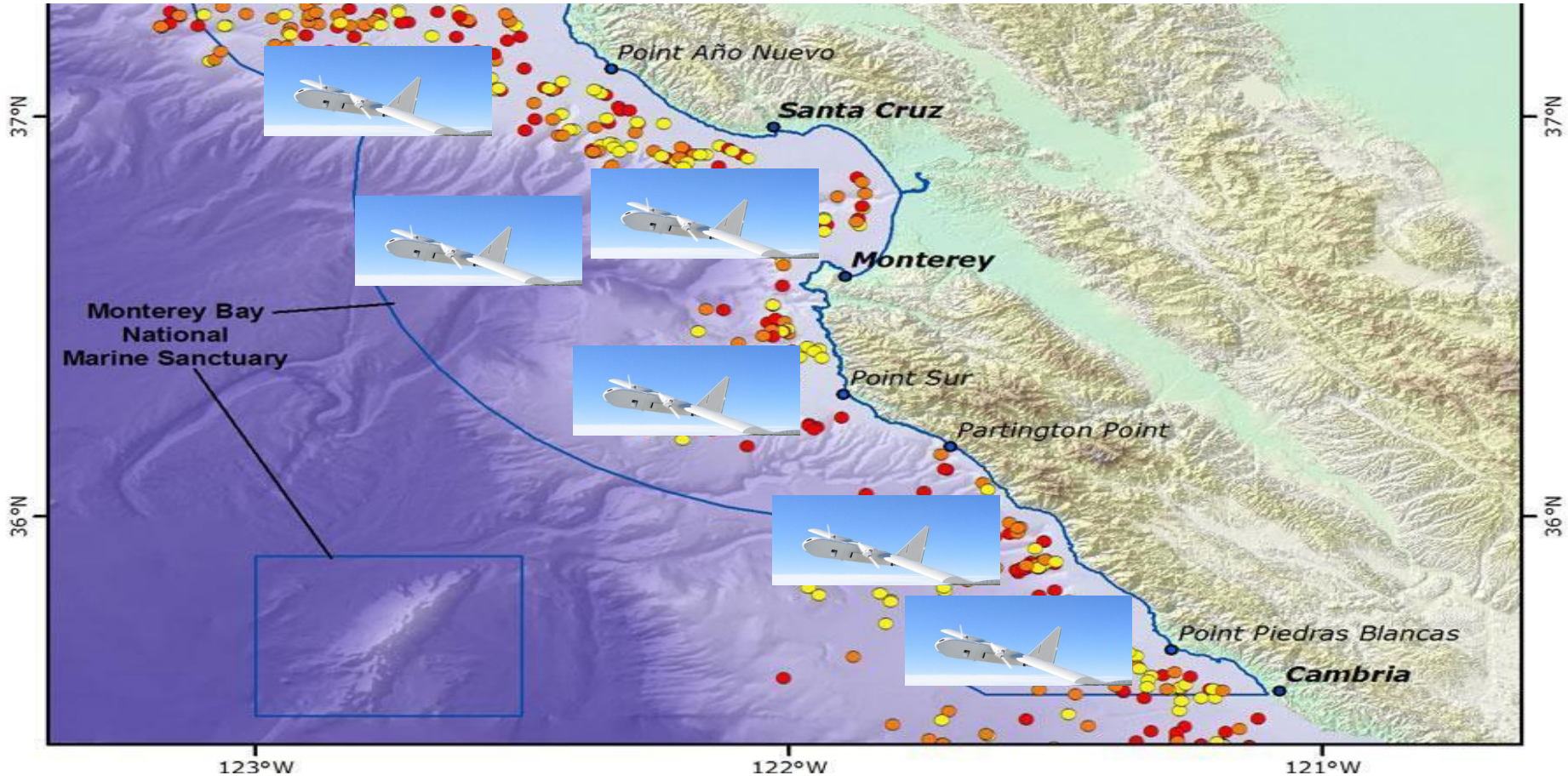
Lawn Mower Play



Intel Placement Play



Swarming

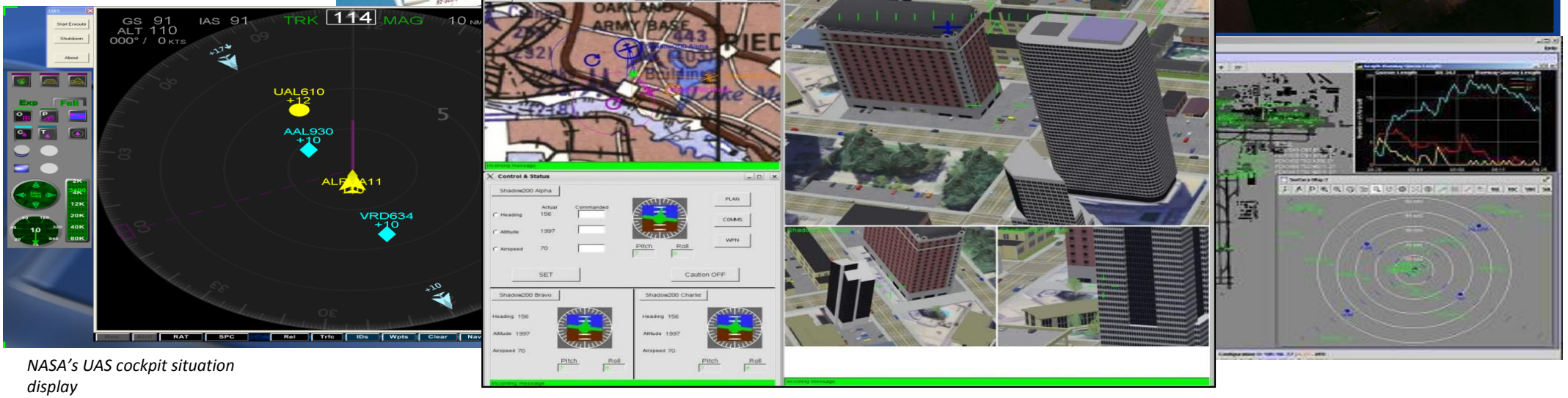


Electronic Phermones to repel – until detection, then attract

Summary

- Potential Areas of Collaboration
  - UAS in the NAS
    - DAA Regulations and Compliance
    - Displays
  - UTM
    - Airspace design and geo-fencing
    - Weather integration
    - Congestion management
    - Separation management
    - Contingency management
  - Multiple Vehicle Control

Questions ?



NASA's UAS cockpit situation display with TCAS advisories