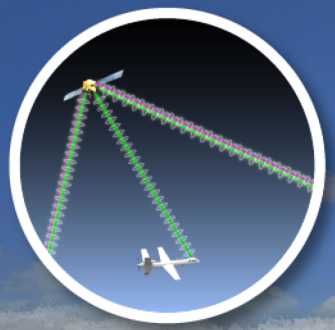
Unmanned Aircraft Systems (UAS) Integration in the National Airspace System (NAS) Project: Project Overview

Robert J. Shhively

NASA's Unmanned Aircraft Systems (UAS) Integration in the National Airspace System (NAS) Project (UAS-NAS) and the UAS Executive Committee (EXCOM) Science and Research Panel (SARP) invite you to attend the 2nd Workshop on Human-Automation Interaction Considerations for UAS Integration. A follow on to the workshop hosted by the National Academies of Science, Engineering and Medicine, this two-day workshop aims to tackle two critical issues for UAS integration in the NAS being addressed by NASA and the SARP: control of multiple UAS by a single, or multiple, operators (multi-UAS), and automatic collision avoidance (auto-CA). Attendees will be asked to generate real human-automation architecture and human machine interface solutions for these problems during interactive breakout sessions. Attendance is limited to select government and academia invitees only. This presentation is an overview to the project .



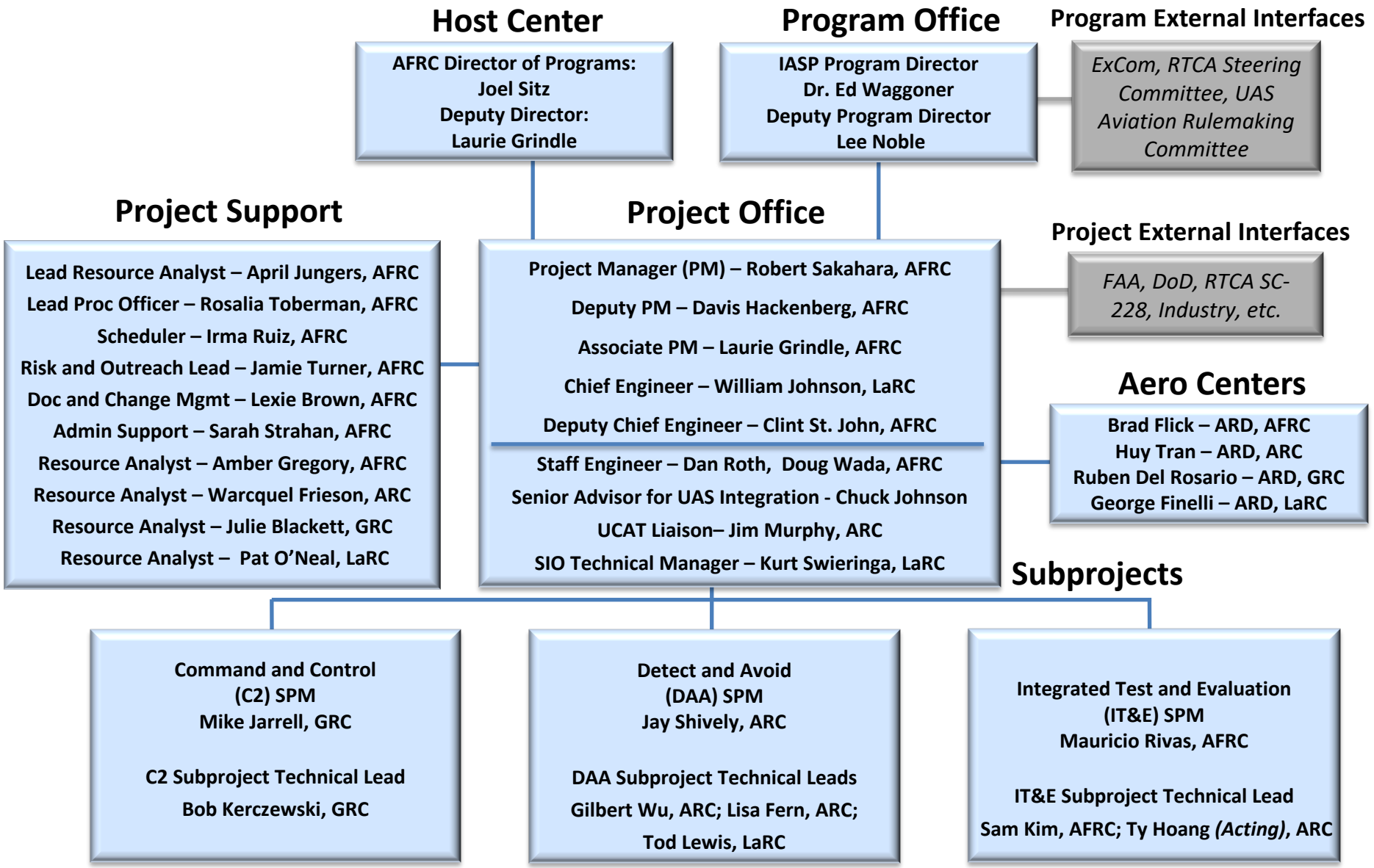
Unmanned Aircraft Systems (UAS) Integration in the National Airspace System (NAS) Project

Jay Shively
Sub-Project Manager, Detect and Avoid
Flight Tests 5 & 6

Full UAS Integration Vision of the Future

Manned and unmanned aircraft will be able to routinely operate through all phases of flight in the NAS, based on airspace requirements and system performance capabilities.

UAS Integration in the NAS Organizational Structure



ARD: Aeronautics Research Director, PM: Project Manager, SPM: Subproject Manager, UCAT: Urban Air Mobility Coordination Assessment Team, SIO: Systems Integration and Operationalization

See and Avoid: FAR Sec. 91.113

General. When weather conditions permit, regardless of whether an operation is conducted under instrument flight rules or visual flight rules, vigilance shall be maintained by each person operating an aircraft so as to see and avoid other aircraft. When a rule of this section gives another aircraft the right-of-way, the pilot shall give way to that aircraft and may not pass over, under, or ahead of it unless well clear.

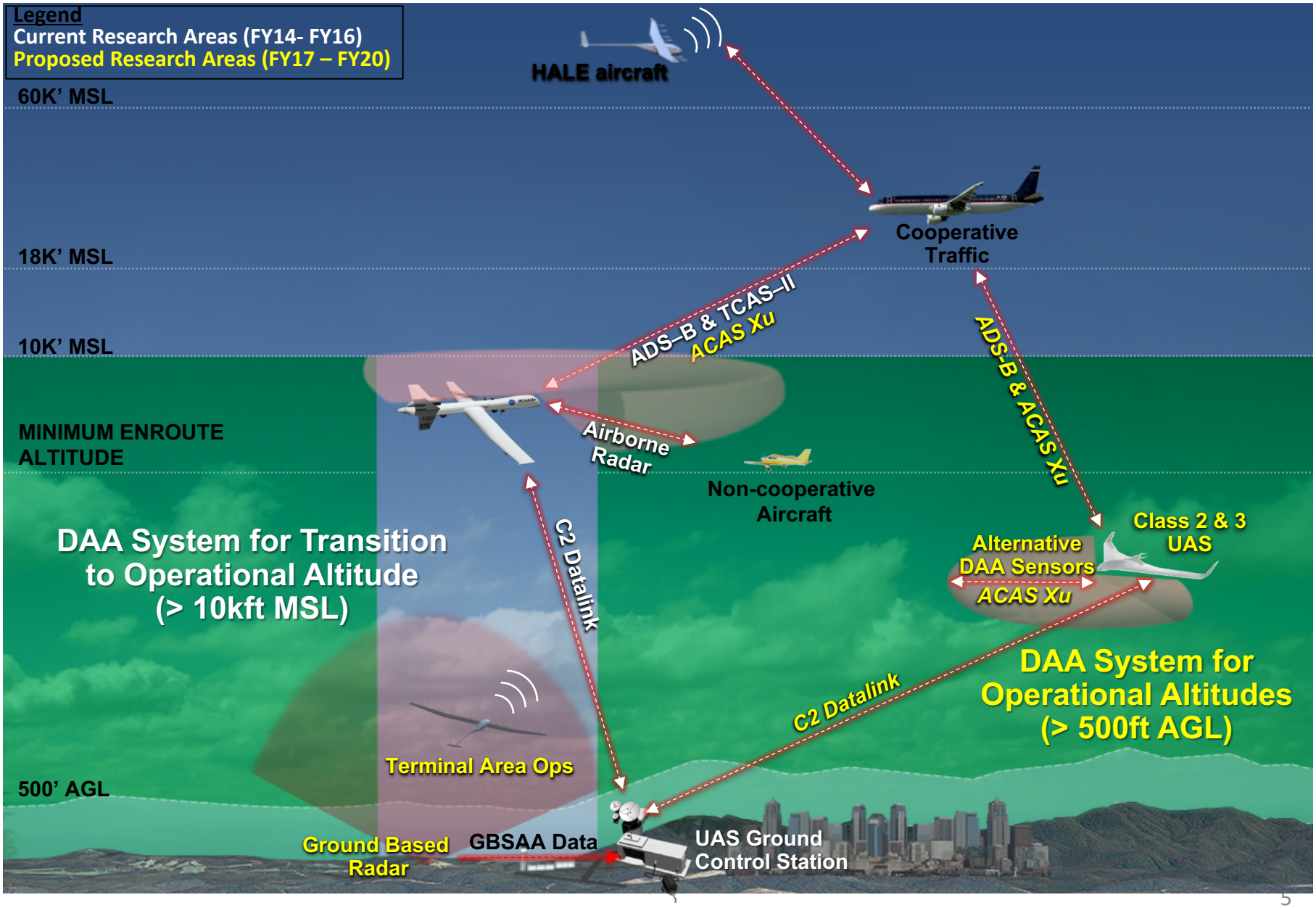
Piloted “see and avoid” = UAS “detect and avoid”

Pilots vision replaced by sensors (on- or off- board or both)

Pilot judgment of well clear = mathematical expression of well clear

Horz Miss Distance = 4000ft; Vert Miss Distance = 450ft;
modTau = 35sec; DMOD = 4000ft

DAA Operational Environments



Phase 1 Accomplishments

DO-366

Minimum Operating Performance Standards (MOPS) for Air-to Air Radar Detect and Avoid (DAA) Systems

Technical Standard Orders

TSO-C211, Detect and Avoid

TSO-C212, ATAR for Traffic Surveillance,

NASA DAA Team Contributions:

- Well clear definition
- Alerting
- Guidance
- Displays
- Reference algorithm
- Significant modeling and simulation

Phase 2

- Well Clear
  - Terminal area
  - Low SWaP
- Low SWaP Sensor
- Algorithm modifications
- Guidance, displays, alerting – tuning
- ACAS-Xu/DAA interop logic
- Well Clear Recovery logic/display
- Pilot response timeline
  - Derived RADAR Requirements (for new sensors)

Multi-UAS Control

See Conrad’s slides…..

Auto-Collision Avoidance
Fall, 2018

- Engineering Analysis
  - Mock up several options
  - Run pilots walk through:
    - Opinions
    - Feasibility

Urban Air Mobility

- Mine-HITL 2018
  - Phase 2 well clear scalability
  - 1 to many control
- 2019 HITL
  - M to N
  - VTOL
  - Gate to gate
- 2020 and beyond
  - Major focus of NASA Aeronautics

Summary

- Ability to influence our HITLs
- Potential to team with NASA
- Potential UAM partnering