Headquarters U.S. Air Force

Integrity - Service - Excellence

DoD UAS Operations in the National Airspace System

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Ex Director OSD PBFA
A3O-B, Bases, Ranges, and Airspace

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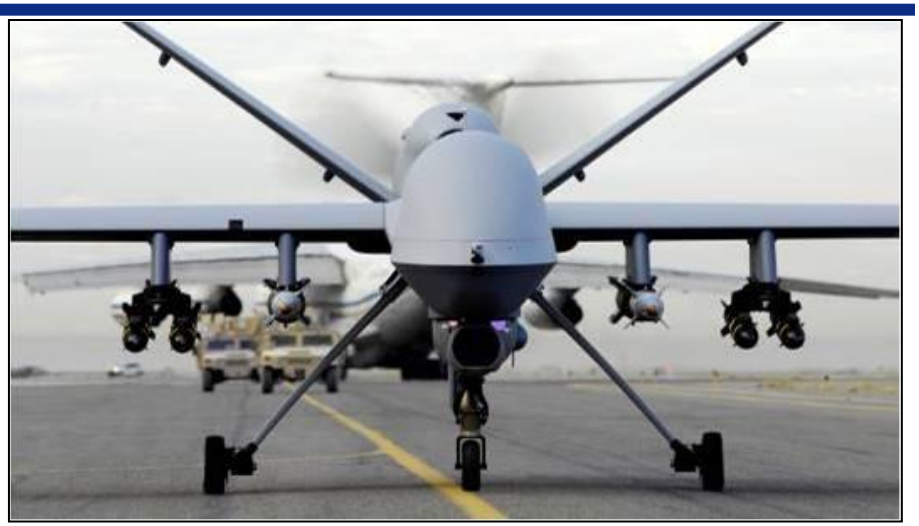
Overview

- NAS Access – 2015 Mandate
- DoD Equities
- NAS Access Process
- Foundational Activities
- UAS R&D
- Questions



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DoD RPA/UAS Airspace Integration Now and Future

- Today: Special Access - Certificate of Authorization
  - Numerous and varied restrictions
  - Inflexible system; FAA and DoD are working improvements
- Mid-term: Routine Access - Policy, procedures and technology permit non-segregated access
  - Ground Based Sense And Avoid (GBSAA)
- Long-term: Normalized Access – Technology development to allow Remotely Piloted Aircraft / Unmanned Aircraft Systems integration into National Airspace
  - GBSAA, Automatic Dependent Surveillance Broadcast, and Airborne Sense and Avoid

DoD RPA/UAS Airspace Integration 2015 Beddown

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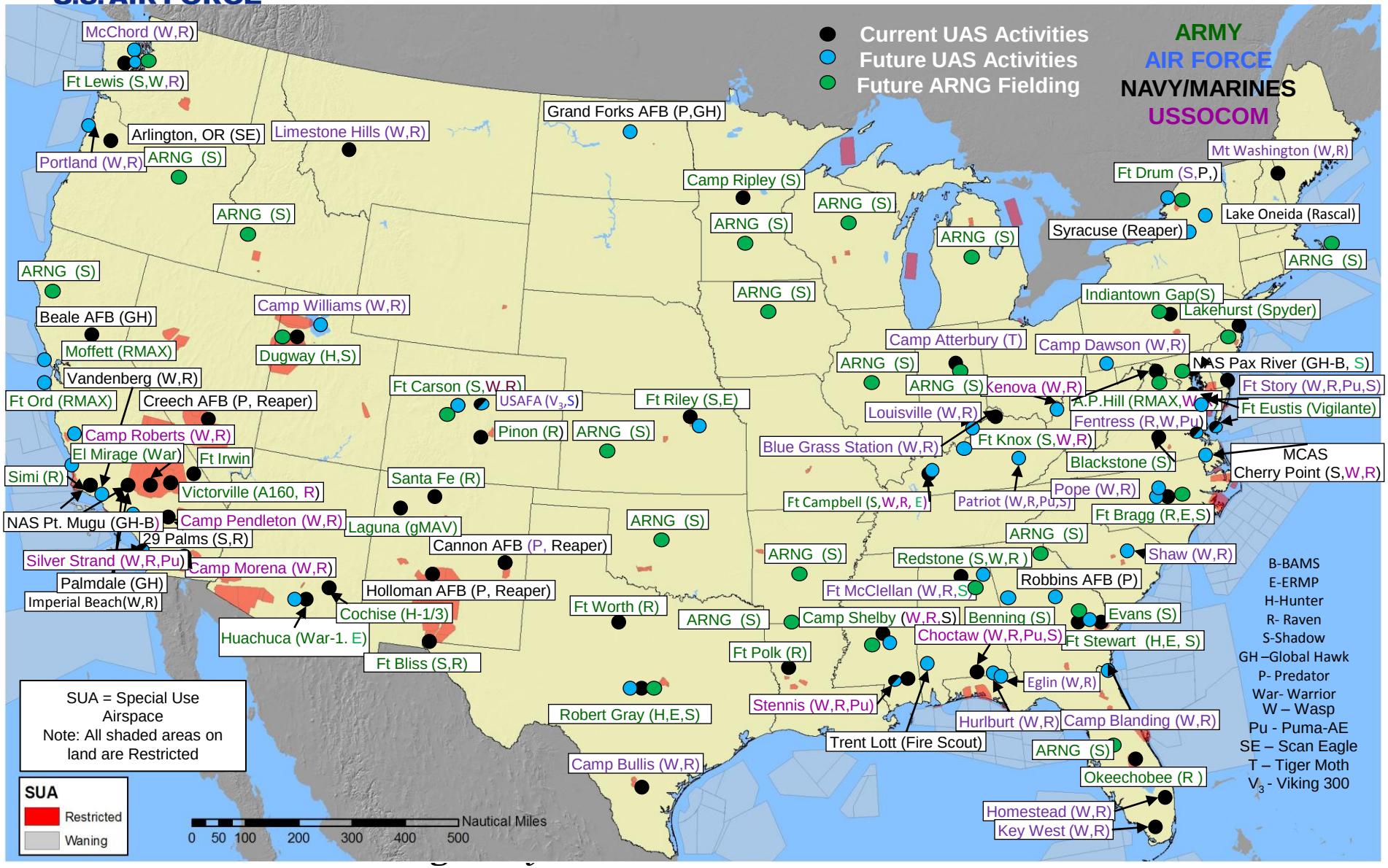

Requirement

DoD UAS Flight Hours (By Department/FY)

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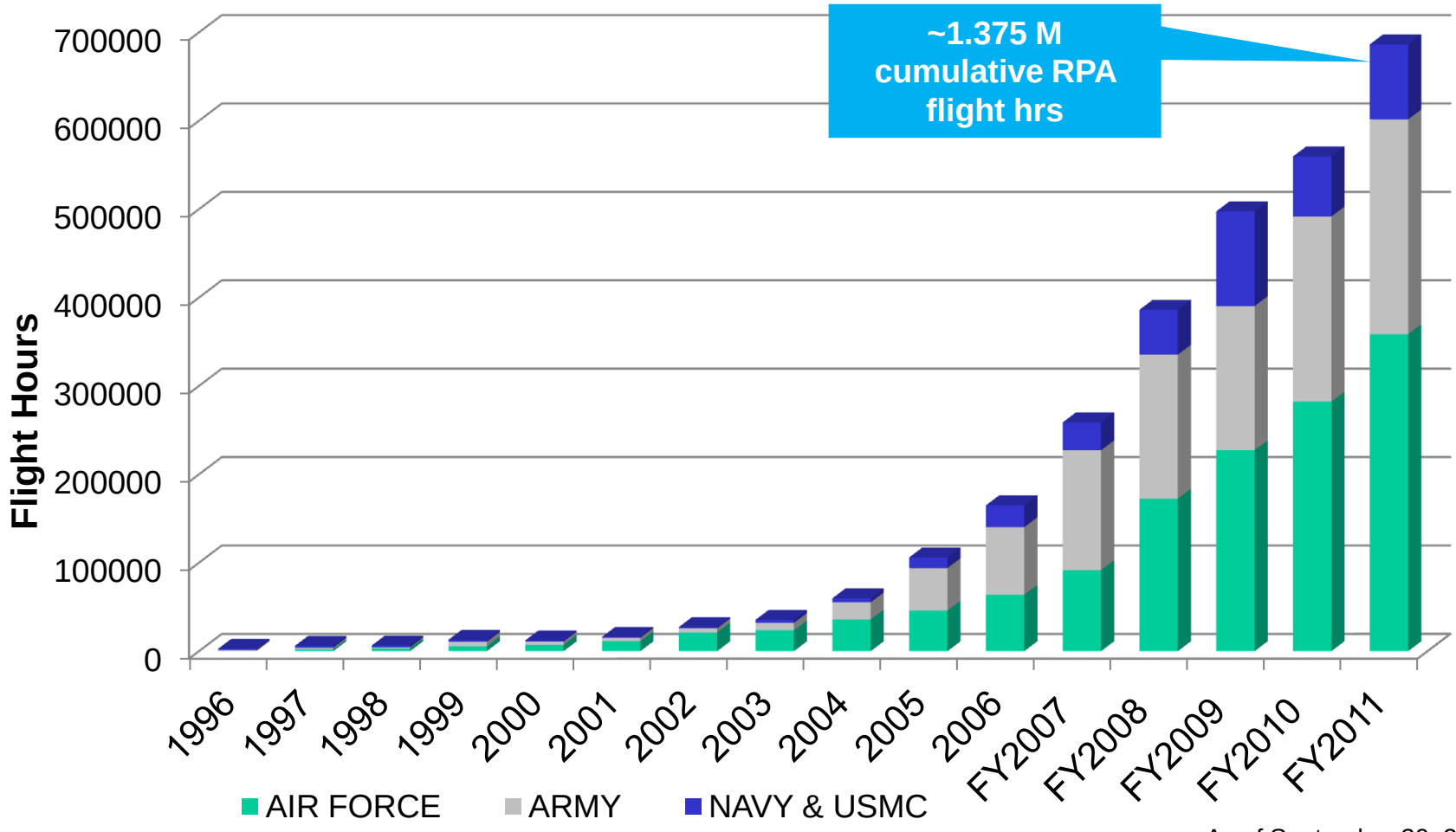

As of September 30, 2011

Does not include Group 1 UAS (e.g., Raven)

FY12 the Air Force is projected to have 15,128 pilots and RPA pilots.
FYI, its 14,913 11X pilots and 215 18X RPA pilots.

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DoD Equities in UAS Integration

Leadership

- DoD is the single largest operator of aircraft in the world
  - The most aircraft (~15,000 total -- 9,808 F/W aircraft, 1,498 Transport/Tanker Aircraft, 5,268 R/W aircraft
  - The most pilots/aircrew ~ 46,000
  - The most experience in all phases of UAS operations
    - 776 Full Sized UAS/RPA, plus 7,244 Small UAS
- Outside of FAA, the DoD is the largest:
  - Regulator of pilots & aircraft
  - Certificator of aircraft and avionics systems
  - Manager of airspace
  - Employer of air traffic controllers (8,183)
  - Operator of airfields and air traffic systems

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DoD Equities in UAS Integration Strengths

DoD enjoys:

- **World-class aviation R&D expertise**
- **Established partnerships with FAA, NASA, DHS and others**
- **Unparalleled control over acft, ops, facilities and airspace**
- **A long history of US aviation/certification firsts:**
  - **Jet propulsion**
  - **Composite materials**
  - **Fly-by-wire**
  - **GPS**

DoD not only has the requirement for NAS Access, we have the resources and expertise to address it

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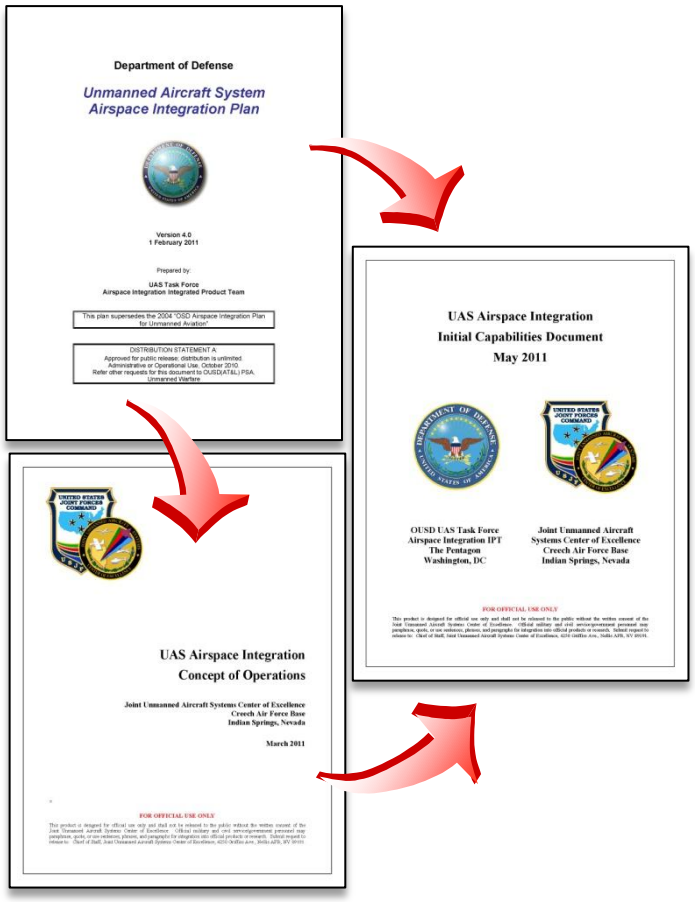
DoD NAS Access Process
Key Documents

- DoD Airspace Integration (AI) Plan
  - Builds foundation and specifies AI approaches/methods
  - Supports AI ICD
- Airspace Integration CONOPS
  - Implements AI Plan approaches and methods and outlines operational processes
  - Supports AI ICD
- AI Initial Capabilities Document (ICD)
  - Formalizes DoD requirement
  - Insertion point into DoD acquisition process



AI Plan: Apr 2011/AI CONOPS: May 2011/AI ICD: 2012

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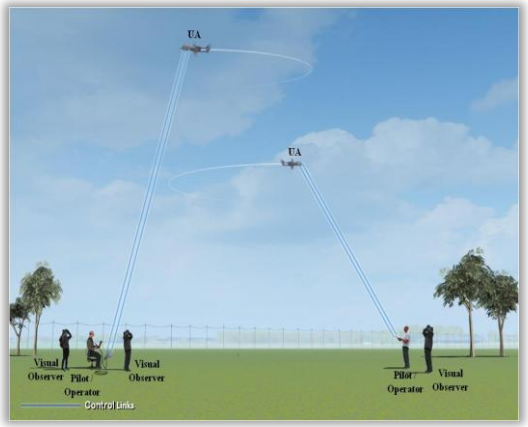
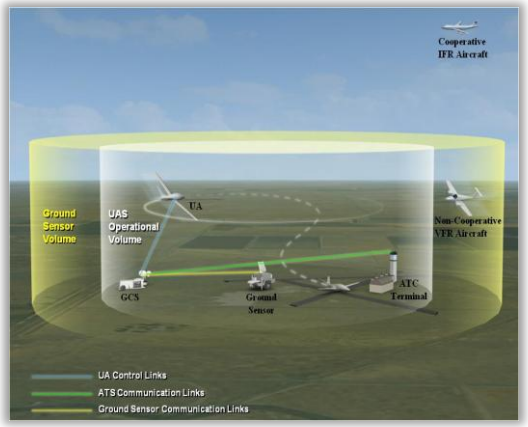
NAS Access Templates

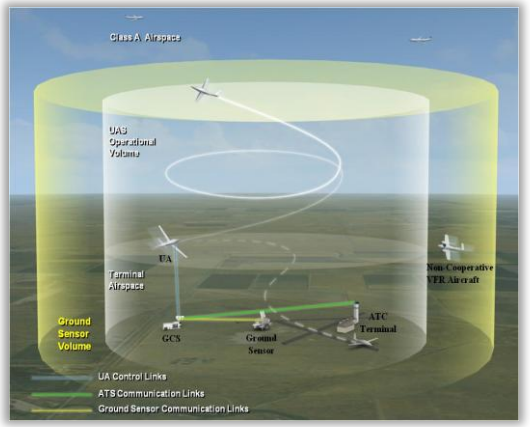
Line-of-Sight Operations



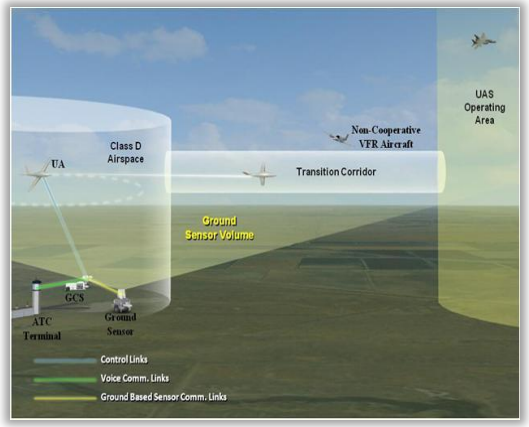
Terminal Area Operations



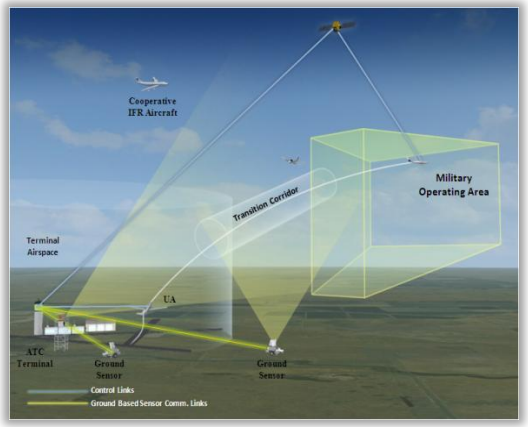
Vertical Transit Operations



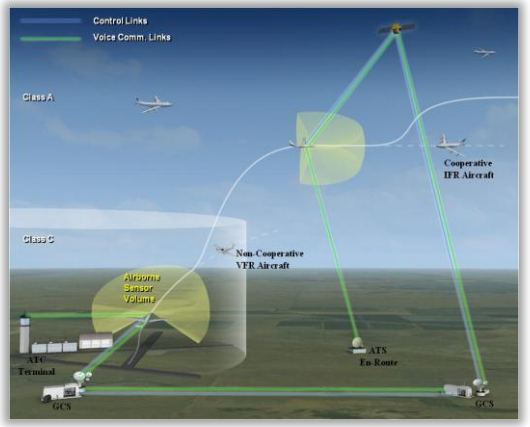
Lateral Transit Operations



Military Operations Area



Dynamic Operations



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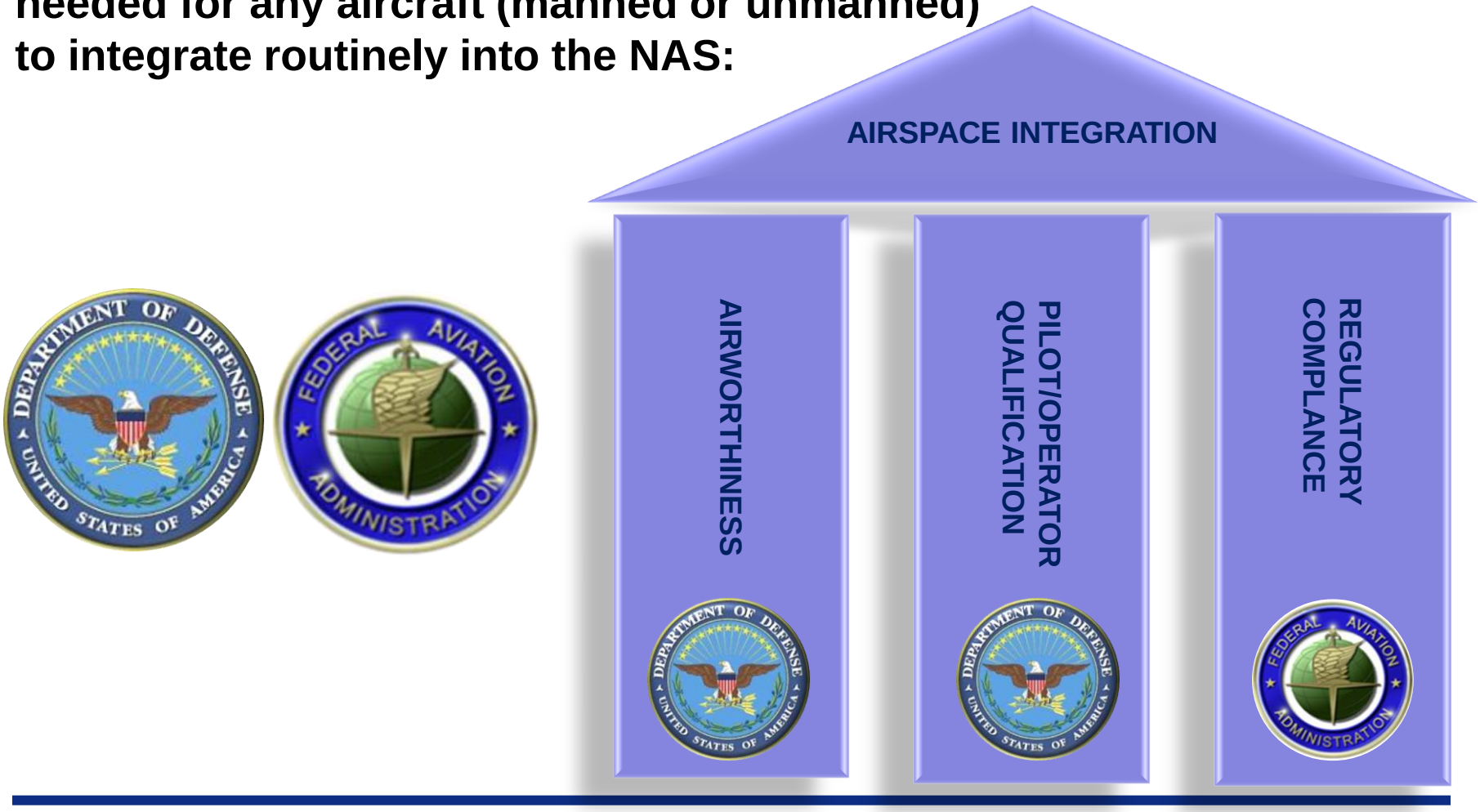
Foundational Activities

There are three foundational requirements needed for any aircraft (manned or unmanned) to integrate routinely into the NAS:



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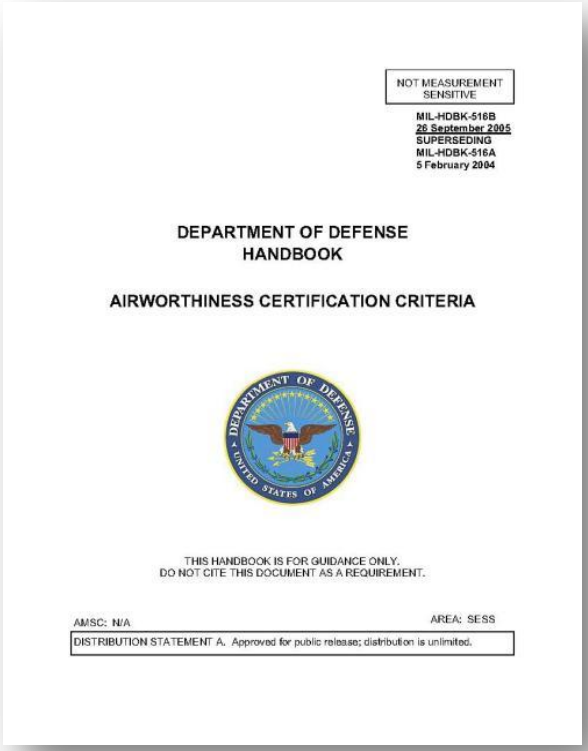
Foundational Activities
Airworthiness

- **Detailed airworthiness criteria for DoD aircraft is published in MIL-HDBK-516**
  - **While the majority of existing guidance is translatable to UAS, there are gaps (C2 link, SAA systems)**
  - **DoD is funding accelerated development of UAS criteria to address those gaps**
  - **Working to ensure technology and standards development keep pace with requirements**


NOT MEASUREMENT SENSITIVE

MIL-HDBK-516B
26 September 2005
SUPERSEDING
MIL-HDBK-516A
5 February 2004

DEPARTMENT OF DEFENSE
HANDBOOK

AIRWORTHINESS CERTIFICATION CRITERIA

THIS HANDBOOK IS FOR GUIDANCE ONLY.
DO NOT CITE THIS DOCUMENT AS A REQUIREMENT.

AMSC: N/A AREA: SESS

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

DoD UAS Airworthiness Criteria is critical to increased NAS access

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Foundational Activities
UAS Pilot/Operator Qualification

- Military pilots do much more than transit the NAS
  - Air combat maneuvering, weapons employment, strategic/tactical payload delivery, surveillance, CAP, etc.
- NAS qualification is integrated into training/certification programs
- Aircraft-specific qualification is required for most platforms
  - UAS are no different
- Military Departments develop and implement training standards
  - Departments self-certify
- DoD instruction (CJCSI 3255.01) provides qualification targets

FAA certifies civil pilots – Services certify and regulate military pilots

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USAF Wings to FAA License Equivalency

	USAF Pilot	USAF RPA Pilot	Private Pilot License Certificate w/instrument rating
Gnd Tng	298 Hours	359 Hours	70 Hours
PILOT CERTIFICATION	- Contact - Dual - Solo - Cross country (w/solo) - Night - Simulated/actual IMC	- Contact - Dual - Solo - Cross country (w/solo) - Night - Simulated/actual IMC	- Basic flight maneuvers - Dual - Solo - Cross country (w/solo) - Night - Simulated/actual IMC
	= 85 Hours	= 39 Hours	= 40 Hours
INSTRUMENT CERTIFICATION	- Navigation - Dual - Solo - Instruments - Approaches - Simulated/actual IMC	- Navigation - Dual - Instruments - Approaches - Simulated/actual IMC - RPA sorties	- Navigation - Dual - Solo - Instruments - Approaches - Simulated/actual IMC
TOTAL FLIGHT & SIM TIME =	*170 Hours*	*146 Hours*	*95 Hours*

USAF training compares favorably to FAA requirements

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Foundational Activities
DoD Regulatory Compliance

- DoD leveraging new technologies, procedures, and policies to address compliance – first to validate, then to certify the results
  - Technologies (sensors, conflict detection)
  - Policies (certification, equipage)
  - Procedures (terminal, avoidance, lost-link)
- DoD has statutory authority to develop, validate, and certify equipment operating UAS in all classes of airspace
- DoD has specific, near-term access requirements
  - CONUS operational/homeland defense/DSCA support
  - Access to/movement within defined operating/training areas
  - Terminal operations, Small UAS training

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Foundational Activities
FAA Regulatory Guidance

- **ExCom/SSG: Streamlined Certificate of Authorization (COA) process; expanded Class D ops, exploring remote area ops**
- **sUAS rule: First national UAS policy; allows ops under specific conditions without COA; final rule delayed but expected in ’12**
- **UAS ARC: Initial stages of developing rules and policy for larger UAS; long-term project. Chartered through FY15**
- **FAAO 8900: Critical update to FAA COA process and procedures; FAA coord’d closely w/ExCom; publication expected in early ’12**
- **Keys to success:**
  - **Identify, scope and target National policy development**
  - **Leverage resources/expertise; collaborative effort required to find optimal solution**

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2012 FAA Reauthorization

- **SEC. 332. INTEGRATION OF CIVIL UNMANNED AIRCRAFT SYSTEMS INTO NATIONAL AIRSPACE SYSTEM**

  …shall develop a comprehensive plan to safely accelerate the integration of civil unmanned aircraft systems into the national airspace system.

  DEADLINE. - The plan required under paragraph (1) shall provide for the safe integration of civil unmanned aircraft systems into the national airspace system as soon as practicable, but not later than September 30, 2015.

- **Requires FAA to establish 6 UAS test ranges in coordination with DoD and NASA**

DoD, NASA and FAA need to work cooperatively to meet congressional UAS Airspace integration mandate

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UAS R&D

- DoD is sponsoring R&D activities through the UAS Task Force
  - Developed an SAA Blueprint to identify gaps and overlaps; shared with industry and academia
- NASA has established Aeronautics Research and Technology Roundtable to examine key trends and the risks facing the U.S. and global aviation systems including UAS
  - $150M across 5 years to assess, develop, and test UAS tech
- FAA is conducting R&D supporting current operations as well as in NextGen timeframe
  - DoD and FAA are coordinating current ops R&D
  - JPDO published R&D Roadmap in an effort to create a responsive, efficient and coordinated multi-agency approach
- Coordination, deconfliction and focus is needed to ensure maximum return on R&D investment dollars

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UAS Test Ranges

- Congressionally Mandated – 2012 NDAA
  - Similar language in FAA reauthorization
  - Requires FAA to establish 6 ranges in coordination w/DoD/NASA
- AF is providing inputs to FAA using basing process experience
  - AF process - Repeatable, defendable and transparent with clearly defined criteria, process, & roles and responsibilities
- Benefits:
  - Provides a joint, structured approach to look at critical UAS airspace integration issues (both civil and military)
  - Allows sharing of UAS data among proponents (DoD, FAA and NASA); helps in identification of research gaps/needs
  - Build industry & academic partnerships enabling more rapid & efficient UAS airspace integration and technology evolution

Exploring the Viability of Cooperative Autonomous Sense and Avoid

Without Remote Pilot Commands

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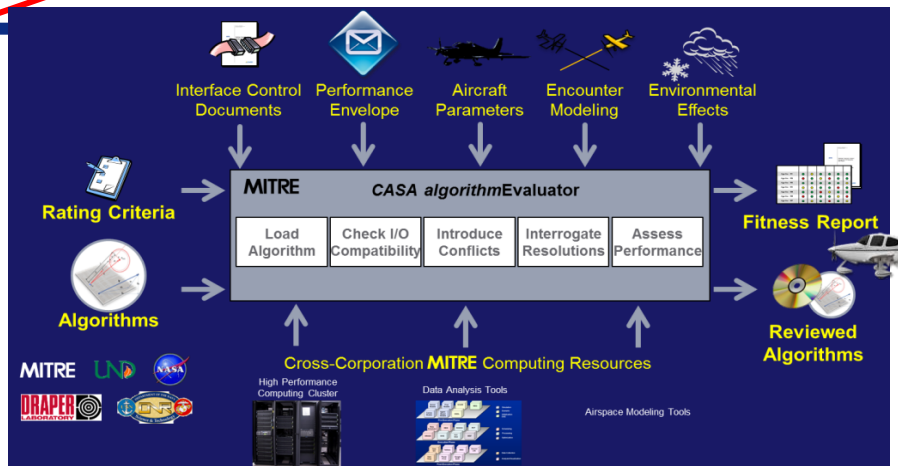
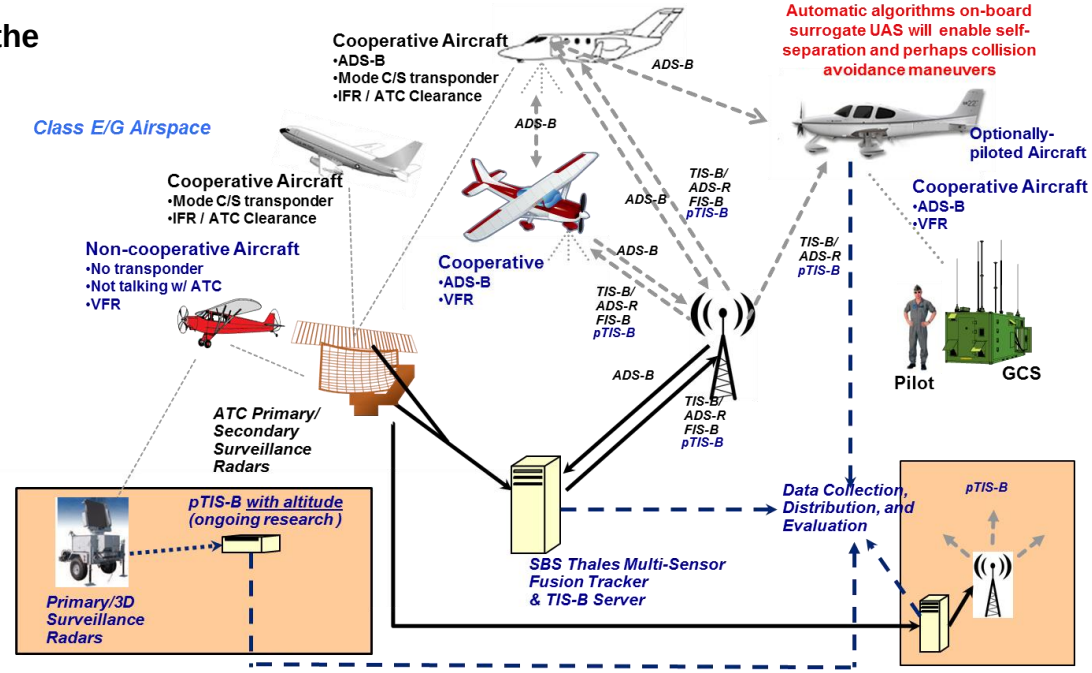
- Community Research Initiative

Automatic Dependent Surveillance – Broadcast (ADS-B)

- Inform policy discussions with operational and technical data
  - Roadmap for future airspace integration
  - Sense and Avoid Performance Criteria and Standards
  - Not intended to help UAS integrate in the next 10+ years
- Create an experimental environment and explore implementation alternatives
  - TIS-B messages from primary radar
  - No airspace access restrictions
  - No changes in operational procedures
- Evaluate Algorithms
- Conduct flight tests of a cooperative automatic sense-and-avoid capability with surrogate UAS
- Outreach with and evaluate impact on General Aviation





AF's UAS Airspace Integration Technology Vision

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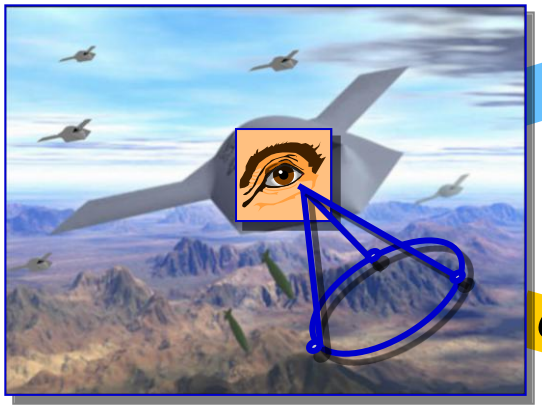
Sense and Avoid Goals/Attributes

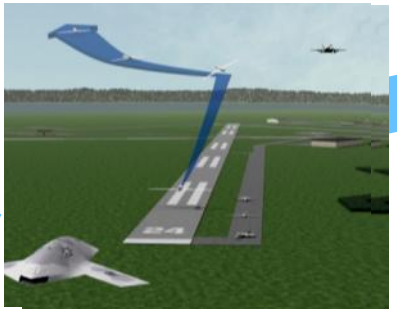
- *Collision Avoidance*
- *Conflict Avoidance*
- *Autonomous*
- *Sensor Fusion*
- *Pilot-like Behavior*

Terminal Area Ops Goals/Attributes

- *Operations in Ground Environment*
- *Operations in Dense Traffic*
- *Less Reliance on GPS*
- *Responsive to ATC*

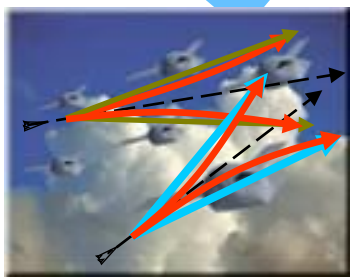


Sense and Avoid



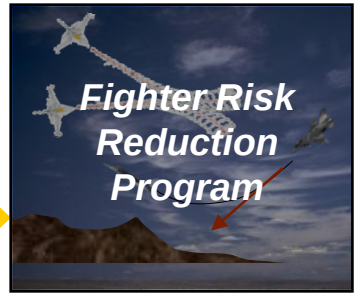
Terminal Area Operations

File and Fly



Auto-Air/Ground Collision Avoidance

Off-Ramp



Off-Ramp

AFRL Autonomous Systems R&D Programs

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Autonomy & Teaming

Enable unmanned platforms adaptable to dynamic environments, as well as synergistic teams that cooperate towards mission goals

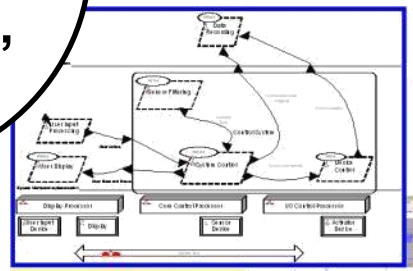
Human-Machine Interaction

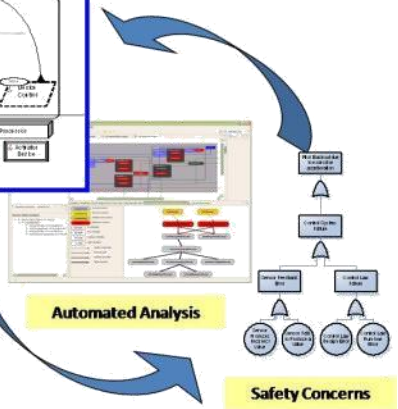
Maximize human performance when integrated with real-time automated systems

"Autonomous as Needed, Interactive as Desired"

Safely integrate unmanned systems into manned airspace, and into airbase operations

Airspace & Airbase Integration





Verify and validate performance of complex, dynamic, automated systems

Trust & Certification

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AF Airborne Sense & Avoid

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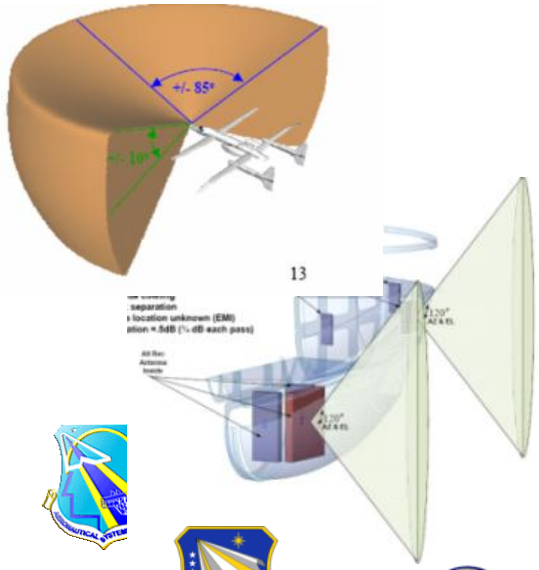
Capabilities Enabled:

- Replacing the human pilot's "See and Avoid" capability is a key element to enable UAS routine airspace access
- Enables operator-initiated or autonomous maneuver to deconflict & avoid collision
- Incorporates cooperative & non-cooperative sensing



Progress:

- Single-intruder autonomous detect/avoid using EO/TCAS (Dec 06)
- Open loop intruder encounters using EO/TCAS/ADSB/surrogate radar (Nov 08)
- Developing SAA radar to HALE UAS size/weight/power limits

Collaboration:

- Navy, FAA, RTCA, DoD, and other groups on requirements/technology issues

Next Step: 1- and 2-intruder flight activity

- EO/TCAS/ADS-B/SAA radar (FY12)

Transition:

- Global Hawk Program Office (FY12)

FAA

NAVAIR

NORTHROP GRUMMAN
Integrated Systems

Bihrle
APPLIED RESEARCH INC

Calspan

CEI
COLORADO ENGINEERING, INC.

SelectTech Services Corporation

DRA

icx
radar systems

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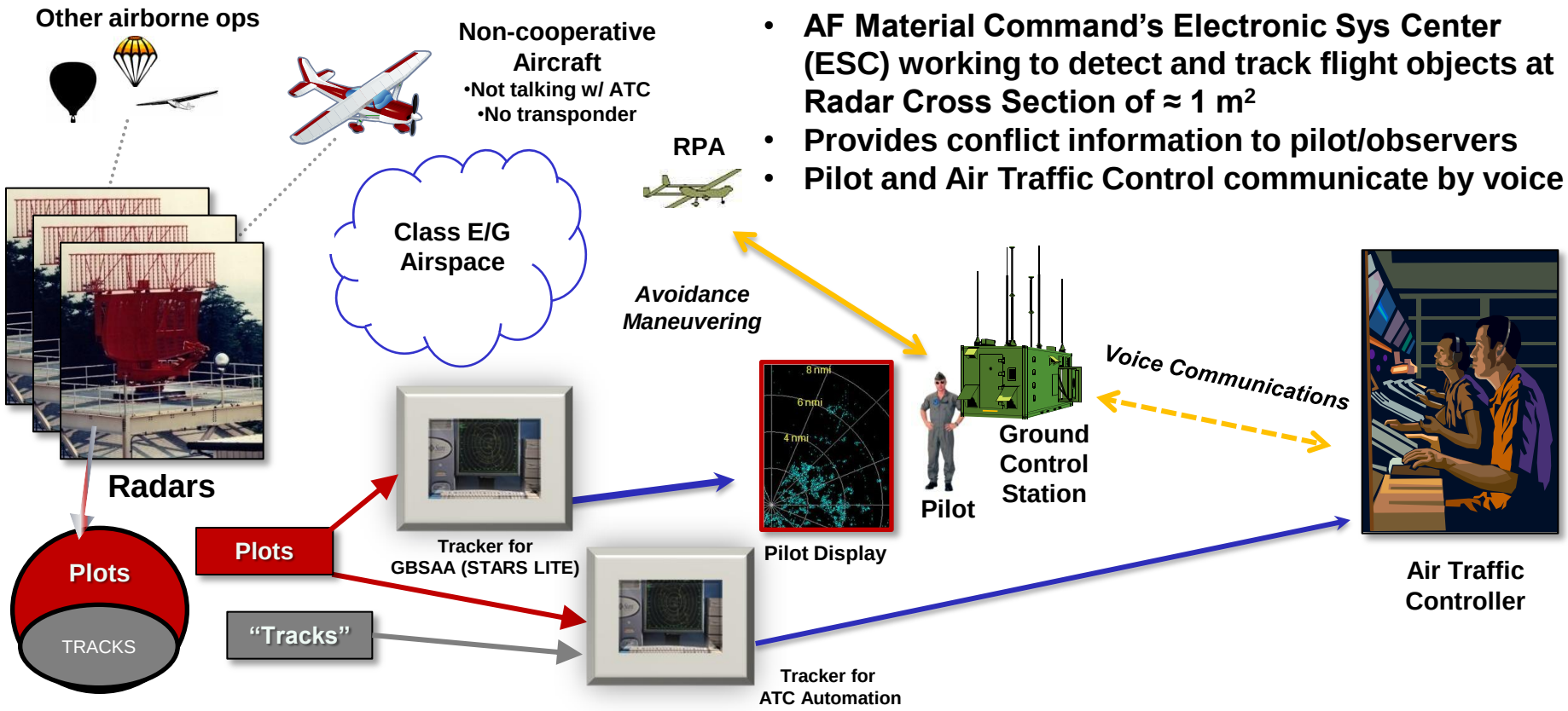
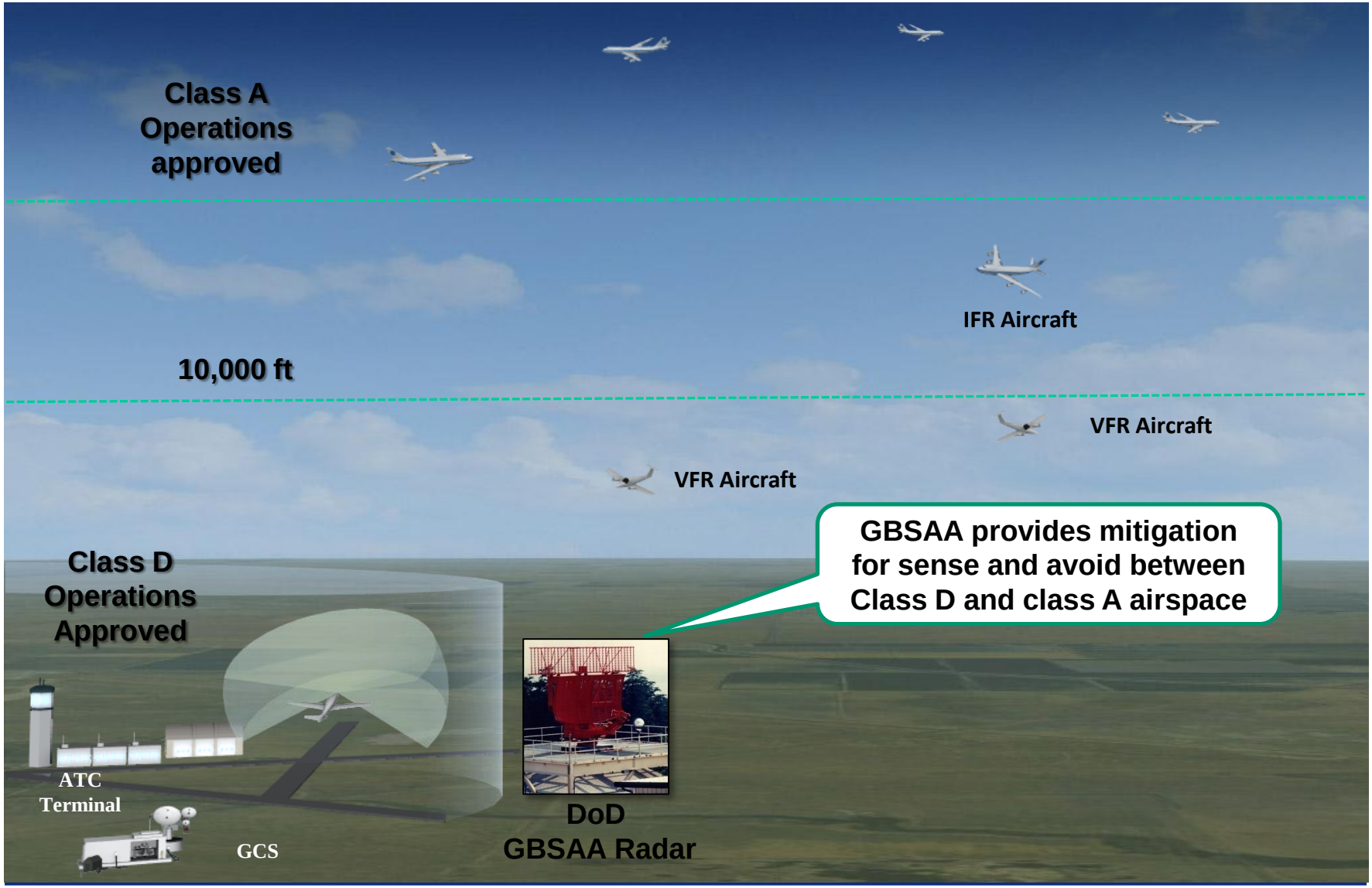
AF Ground Based Sense and Avoid Concept

- AF Material Command's Electronic Sys Center (ESC) working to detect and track flight objects at Radar Cross Section of ≈ 1 m^2
- Provides conflict information to pilot/observers
- Pilot and Air Traffic Control communicate by voice



Radar & Tracker	+	Concept of Employment	+	Safety Study	+	Policy & Procedures	=	Routine NAS Access
(Electronic System Ctr)		(ESC and MAJCOM)		(AF Safety Ctr)		(AF Flt Std Agency) (MAJCOM sets ops rqmts)		

GBSAA Solution



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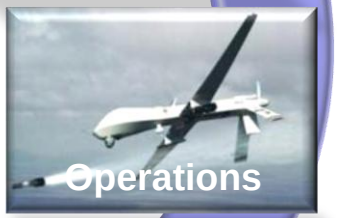
Next R&D Steps

- AF, Services & OSD are developing & implementing UAS access solutions
- AF Research Lab well-positioned to collaborate with FAA/NASA to do the research and answer the key FAA questions needed to allow for UAS integration
- Team with key stakeholders to address research goals in a cooperative manner



Together, AF/DoD & FAA have the competencies to Design and Validate UAS NAS Standards

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Summary

- Integrate UAS into NAS by 2015
- DoD's UAS NAS access requirements are quickly increasing
- DoD intent: Integrate vice segregate UAS Ops in NAS
- DoD identified near, mid, and far-term UAS access requirements--in a construct that is incrementally achievable
- Updating UAS Airworthiness Cert: DoD processes for operational procedure development (CONOPS) and tech development
- Coordination of R&D efforts key to success in the current fiscally constrained environment