DoD UAS Operations in the National Airspace System

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Overview

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

Current UAS Activities
Future UAS Activities
Future ARNG Fielding

SUA = Special Use Airspace
Note: All shaded areas on land are Restricted
Does not include Group 1 UAS (e.g., Raven)

As of September 30, 2011

~1.375 M cumulative RPA flight hrs
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
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.
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

NAS Access Templates

I n t e g r i t y - S e r v i c e - E x c e l l e n c e
There are three foundational requirements needed for any aircraft (manned or unmanned) to integrate routinely into the NAS:
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

**DoD UAS Airworthiness Criteria is critical to increased NAS access**
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
# USAF Wings to FAA License Equivalency

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<th>Ground Training</th>
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<th>298 Hours</th>
<th>USAF RPA Pilot</th>
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**TOTAL FLIGHT & SIM TIME:**

- USAF training compares favorably to FAA requirements

![USAF Wings to FAA License Equivalency Chart](chart.png)
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
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
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
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
**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

Community Research Initiative

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

I n t e g r i t y - S e r v i c e - E x c e l l e n c e
AF’s UAS Airspace Integration Technology Vision

**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

**Auto-Air/Ground Collision Avoidance**

**Fighter Risk Reduction Program**

**Sense and Avoid**

**Sense And Avoid**
- FY12 Transition to GlobalHawk/BAMS
- Multi-UAS Sense and Avoid Sensor Miniaturization
- SAA applicable to Class 2-5 UAS

**Terminal Area Operations**

**File and Fly**

**Integrity - Service - Excellence**
AFRL Autonomous Systems R&D Programs

Autonomy & Teaming

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

Airspace & Airbase Integration

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

Human-Machine Interaction

- Maximize human performance when integrated with real-time automated systems.

“Autonomous as Needed, Interactive as Desired”

- Verify and validate performance of complex, dynamic, automated systems.

Trust & Certification

- Control System Models
- Automated Analysis
- Safety Concerns
AF Airborne Sense & Avoid

U.S. AIR FORCE

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)

Integrity - Service - Excellence
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 m²
- Provides conflict information to pilot/observers
- Pilot and Air Traffic Control communicate by voice

Other airborne ops

Class E/G Airspace

Non-cooperative Aircraft
- Not talking w/ ATC
- No transponder

RPA

Avoidance Maneuvering

Ground Control Station

Voice Communications

Tracker for ATC Automation

Tracker for GBSAA (STARS LITE)

Pilot Display

Pilot

Air Traffic Controller

Plots

“Tracks”

Radar & Tracker

(ESC and MAJCOM)

Policy & Procedures

(AF FIt Std Agency)

Safety Study

(AF Safety Ctr)

Routine NAS Access

Concept of Employment

(ESC and MAJCOM)

Radar & Tracker

(Electronic System Ctr )
GBSAA Solution

Class A Operations approved

Class D Operations Approved

10,000 ft

ATC Terminal

GCS

DoD GBSAA Radar

VFR Aircraft

IFR Aircraft

GBSAA provides mitigation for sense and avoid between Class D and class A airspace

I n t e g r i t y  -  S e r v i c e  -  E x c e l l e n c e
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
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