Department of Defense
Final Report to Congress on
Access to National Airspace for
Unmanned Aircraft Systems

Under Secretary of Defense
(Acquisition, Technology and Logistics)

October 2010

Department of Defense and Department of Transportation
Final Report
on
Access to National Airspace for Unmanned Aircraft Systems (UAS)

This final report, generated in response to direction contained in Section 935(c) of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2010, Public Law 111-84, provides information describing Department of Defense (DoD) and Department of Transportation (DoT) efforts to jointly develop a plan for providing expanded access to national airspace for Unmanned Aircraft Systems (UAS) of the DoD. This report expands on the information provided in the April 2010 Interim Report and has been coordinated between DoD, DoT and Department of Homeland Security (DHS).

SECTION 935(c) REPORTING REQUIREMENT

(a) IN GENERAL.—The Secretary of Defense and the Secretary of Transportation shall, after consultation with the Secretary of Homeland Security, jointly develop a plan for providing expanded access to the national airspace for unmanned aircraft systems of the Department of Defense.

"(b) ELEMENTS.—The plan required by subsection (a) shall include the following:

(1) A description of how the Department of Defense and the Department of Transportation will communicate and cooperate, at the executive, management, and action levels, to provide expanded access to the national airspace for unmanned aircraft systems of the Department of Defense.

(2) Specific milestones, taking into account the operational and training needs of the Department of Defense and the safety and air traffic management needs of the Department of Transportation, for providing expanded access to the national airspace for unmanned aircraft systems and a transition plan for sites programmed to be activated as unmanned aerial system sites during fiscal years 2010 through 2015.

(3) Recommendations for policies with respect to use of the national airspace, flight standards, and operating procedures that should be implemented by the Department of Defense and the Department of Transportation to accommodate unmanned aircraft systems assigned to any State or territory of the United States.

(4) An identification of resources required by the Department of Defense and the Department of Transportation to execute the plan.

(c) REPORT.—Not later than 180 days after the date of the enactment of this Act, the Secretary of Defense and the Secretary of Transportation shall submit a report containing the plan required by subsection (a) to the following committees:

(1) The congressional defense committees.

(2) The Committee on Commerce, Science, and Transportation of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives.

(3) The Committee on Homeland Security and Government Affairs of the Senate and the Committee on Homeland Security of the House of Representatives."

DEVELOPMENT OF A PLAN FOR PROVIDING EXPANDED ACCESS TO THE NATIONAL AIRSPACE FOR UNMANNED AIRCRAFT SYSTEMS OF THE DEPARTMENT OF DEFENSE

Element 1 – Department of Defense and Department of Transportation Communication and Cooperation Plan for Expanded Access to National Airspace for Unmanned Aircraft Systems of the Department Of Defense.

The Departments of Defense (DoD) and Transportation (DoT) have jointly agreed to communicate and cooperate on activities regarding expanded access to national airspace for Unmanned Aircraft Systems (UAS) through the formation of a multi-agency Executive Committee on UAS Integration.

Background

In Section 1036 of the Duncan Hunter NDAA for FY 2009, Public Law 110-417, dated October 14, 2008, the U.S. Congress recommended that the DoD and the FAA form an Executive Committee (ExCom) to act as a focal point for resolution of issues on matters of policy and procedures relating to UAS access to the National Airspace System (NAS). The sense of Congress was that progress has been lagging in the integration of UAS into the NAS for operational training, operational support to the Combatant Commanders, and support to domestic authorities in emergencies and natural disasters. Additionally, the NDAA language suggested that techniques and procedures should be rapidly developed to temporarily permit the safe operation of public UAS within the NAS until more permanent solutions can be developed or identified.

In response to the 2009 NDAA language, the Deputy Secretary of Defense sent a letter[1] to the Deputy Secretary of Transportation recommending that a joint FAA/DoD executive committee be formed to:

1. Act as a focal point for the resolution of pertinent UAS issues between the DoD and the FAA; and
2. Identify solutions to the range of technical, procedural, and policy concerns arising in the integration of UAS into the NAS.

The Deputy Secretary of Transportation response[2] concurred with the establishment of the UAS Executive Committee, and additionally recommended that Committee membership be expanded to include other government agencies that have equity in UAS NAS integration progress. The letter also instructed the FAA to work with DoD representatives to establish the UAS Executive Committee.

In subsequent discussions between executives from DoD and FAA, it was agreed that UAS Executive Committee membership should be expanded to include the Department of Homeland Security (DHS) and the National Aeronautics and Space Administration (NASA) to capture more broadly other federal agency efforts and equities related to integration of UAS into the NAS.

[1] Letter from Deputy Secretary of Defense to Deputy Secretary of Transportation, 9 March 2009
[2] Letter from Deputy Secretary of Transportation to Deputy Secretary of Defense, 27 April 2009

Following coordination between the member agencies and appointment of executive-level representatives, the first meeting of the UAS Executive Committee was held on October 30th, 2009.

Organization

UAS Executive Committee membership consists of two members each from the FAA and the DoD, and one member each from DHS and NASA. Appointed Members of the Committee are:

- **FAA: Mr. Hank Krakowski**, Chief Operating Officer, Air Traffic Organization and **Ms. Margaret Gilligan**, Associate Administrator for Aviation Safety
- **DoD: Mr. David Ahern**, Director, Portfolio Systems Acquisition, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, and **Mr. Steven Pennington**, Acting Executive Director, DoD Policy Board on Federal Aviation
- **DHS: Mr. Rafael Borras**, Under Secretary for Management
- **NASA: Dr. Jaiwon Shin**, Associate Administrator, Aeronautics Research Mission Directorate

ExCom administrative leadership will be rotated throughout the member organizations annually, with the FAA assuming this function for the first year.

There are three levels within the UAS Executive Committee structure (Figure 1):

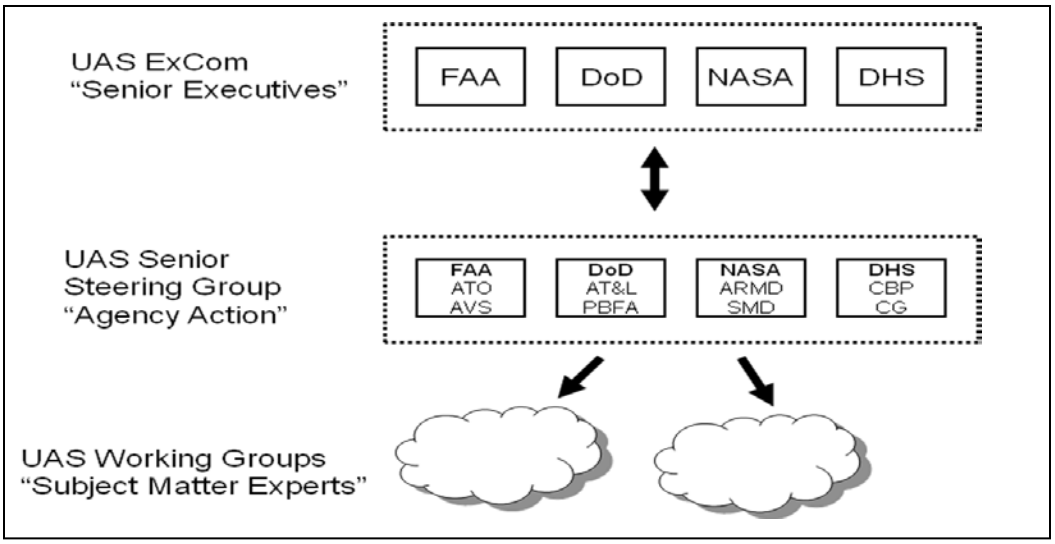


Figure 1. UAS ExCom Structure

The UAS ExCom Senior Steering Group (SSG) consists of officials that can commit their agency to action from the UAS Executive Committee Member organizations. The UAS ExCom SSG administrative leadership will be rotated throughout the member organizations annually, with the DoD assuming this function for the first year. The UAS ExCom Working Groups are organized and chartered as needed to address specific tasks as directed by the Senior Steering

Group. All member organizations provide resources to support the UAS ExCom SSG and Working Groups.

Mission and Focus

The mission of the UAS Executive Committee is "to enable increased and ultimately routine access of Federal UAS engaged in public aircraft operations into the NAS to support operational, training, development and research requirements of the FAA, DoD, DHS and NASA[3]". The initial focus of the UAS Executive Committee is on those efforts that will provide near term access for UAS operated by federal agencies.

Goals

The UAS Executive Committee has identified four key goals[4]:

Goal 1. Coordinate and align efforts among key Federal Government agencies (FAA, DoD, DHS, and NASA) to ultimately achieve routine safe federal public UAS operations in the National Airspace System.

Goal 2. Coordinate and prioritize technical, procedural, regulatory, and policy solutions needed to deliver incremental capabilities.

Goal 3. Develop a plan to accommodate the larger stakeholder community, at the appropriate time.

Goal 4. Resolve conflicts among Federal Government agencies (FAA, DoD, DHS, and NASA), related to the above goals.

Current Activities and Reporting Timeline

As of this report, the UAS Executive Committee's Senior Steering Group has chartered Working Groups to address two key issues:

1. Optimizing the FAA's review and approval process for UAS flights under a Certificate of Waiver or Authority (COA)
2. Development of a Federal UAS NAS Access Plan

The COA Working Group is focused upon near-term process improvements that will enable more ready access to the NAS for Federal UAS. The recommendations contained in the COA Working Group's report to the UAS ExCom SSG will form the basis for implementation actions by the member organizations. The COA Working Group's Phase I recommendations on procedures presented to the UAS ExCom SSG and UAS Executive Committee in January 2010 are now being implemented. The Phase II recommendations for policy and operations were presented to the UAS Executive Committee in July 2010 and are now being refined and developed on a priority basis.

The UAS NAS Access Working Group delivered a *National Airspace System Access Plan for Federal Public Unmanned Aircraft Systems* to the UAS ExCom SSG and UAS Executive

[3] UAS Executive Committee Charter, October, 2010
[4] UAS Executive Committee Charter, October, 2010

Committee. The plan was coordinated in the ExCom agencies and is submitted as part of this final report.

Element 2 – Milestones for Providing Expanded Access to the National Airspace for Unmanned Aircraft Systems and a Transition Plan for Sites Programmed to be Activated as Unmanned Aircraft System Sites During Fiscal Years 2010 through 2015.

Milestones

The attached *National Airspace System Access Plan for Federal Public Unmanned Aircraft Systems* includes identification of appropriate milestones specified in Section 935(b)(2).

Transition Plan

The DoD, through the Military Departments, has identified locations with current and planned UAS activity through 2015 in the attached *DoD UAS Transition Plan.*

Element 3 – Policy Recommendations with respect to Use of the National Airspace, Flight Standards, and Operating Procedures that should be implemented by the Department of Defense and the Department of Transportation to accommodate Unmanned Aircraft Systems assigned to any State or Territory of the United States.

Policy recommendations for national airspace use, flight standards, and operating procedures are included in the attached *National Airspace System Access Plan for Federal Public Unmanned Aircraft Systems*.

Element 4 – Identification of resources required by the Department of Defense and the Department of Transportation to execute the plan.

The *National Airspace System Access Plan for Federal Public Unmanned Aircraft Systems* outlines a process that the ExCom will use to identify the resources required to execute the plan and its recommendations. Most of the short term activity dealing with policy and procedure changes will be covered with the ExCom agencies current planned resources. Mid to far term requirements, particularly for technical solutions, will be identified in their future budget submissions.

SUMMARY

The Secretaries of Defense and Transportation, in partnership with the Secretary of Homeland Security and the Administrator of the National Aeronautics and Space Administration, have formed an UAS Executive Committee to:

1. Act as a focal point for the resolution of pertinent UAS issues between the DoD and the FAA; and

2. Identify solutions to the range of technical, procedural, and policy concerns arising in the integration of UAS into the NAS.

This UAS Executive Committee will be the focal point for communication and cooperation on activities regarding expanded access to national airspace for UAS.

The UAS Executive Committee developed a plan for providing expanded access to the national airspace for unmanned aircraft systems of Federal Agencies. The attached *National Airspace System Access Plan for Federal Public Unmanned Aircraft Systems* provides policy recommendations, implementation milestones, and outlines a process for identifying resource requirements necessary to achieve expanded access for federal public UAS. Additionally the attached *DoD UAS Site Transition Plan* identifies locations with current and planned UAS activity through 2015.

Attachments:
1. National Airspace System Access Plan for Federal Public Unmanned Aircraft Systems
2. DoD UAS Site Transition Plan

ATTACHMENT 1

National Airspace System Access Plan for Federal Public Unmanned Aircraft Systems

October 2010

Prepared by:
UAS ExCom NAS Access Working Group

Executive Summary

Over the past decade, Unmanned Aircraft Systems (UAS) have become an integral part of the United States (U.S.) Military and Government operations. Currently, over 10 different types and over 6,000 unmanned aircraft (UA) are fielded and/or deployed within the Military Services, and additional public UAS are operational with Other Government Agencies (OGAs).[1]

Unmanned aircraft of the Department of Defense (DoD), Department of Homeland Security (DHS), and National Aeronautics and Space Administration (NASA) have a need for safe and routine access to U.S. airspace in order to execute a wide range of missions including surveillance and tracking operations, training, test and evaluation, and scientific data collection. UAS are already a significant part of DoD, DHS, and NASA operations and will eventually require U.S. National Airspace System (NAS) access similar to manned aircraft.

Current UAS lack capabilities similar to what manned aircraft require to operate in the NAS. The lack of comprehensive regulations, procedures, and standards addressing UAS significantly influence how, when, and where UAS operations may occur. Current UAS performance limits UAS NAS operations to Restricted and/or Warning Areas, or requires authorization through application and approval under a Federal Aviation Administration (FAA) Certificate of Waiver or Authorization (COA). These airspace access limitations do not support near-, mid-, or long-term objectives for UAS NAS operations at current or projected operational tempos.

The challenges to UAS Airspace Integration are multi-dimensional. They are influenced by the differences in UAS types and capabilities, missions, numerous classes and types of airspace, governmental requirements, available technologies, and specific mission needs. The challenges are identified in this Plan as regulatory, policy and procedural, standards, and technology.

Public operators of UAS have a goal to have appropriately equipped UAS gain routine access to the NAS in support of domestic operations, exercises, training, and testing. The FAA's goal is to ensure all UAS operations are conducted safely, present no threat to the general public, and do no harm to other users of the NAS.[2] To reach these collective goals, the DoD, FAA, DHS, NASA, and aviation standards development organizations are collaborating in an effort to incrementally address the range of challenges confronting UAS airspace integration.

The recommendations contained herein offer incremental considerations to focus on current limitations affecting UAS integration into the NAS. Near-term efforts may help increase UAS access to the NAS immediately, while a full set of regulations, policy and procedures, standards, and technology must be developed and considered to allow UAS appropriate access to the NAS in a safe and efficient manner.

[1] OUSD AT&L UAS Summit Briefing presented by Dyke Weatherington, 24 March 2009
[2] Deputy Secretary of Defense Memorandum, Memorandum of Agreement for Operation of Unmanned Aircraft Systems in the National Airspace System, 24 September 2007

Table of Contents

List of Figures

List of Tables

1 INTRODUCTION

This National Airspace System (NAS) Access Plan for Federal Public Unmanned Aircraft Systems is the result of direction from Congress for Government agencies to work more closely and collaboratively in introducing UAS safely and more broadly into the NAS to meet the operational and regulatory needs of key government stakeholders.

As a result of the guidance provided in section 1036 of the National Defense Authorization Act (NDAA) for Fiscal Year 2009,[3] the DoD and FAA formed a UAS Executive Committee (ExCom) to focus on conflict and policy resolution, as well as technical and procedural challenges related to UAS operations within the NAS. Subsequent discussions between DoD and FAA executives led to the addition of DHS and NASA to the ExCom due to their comparable UAS operational challenges.

Subsequently, section 935 of the NDAA for Fiscal Year 2010, Public Law 111-84, directs the DoD and Department of Transportation (DOT), after consultation with DHS, to jointly develop a plan to provide expanded access to national airspace for DoD UAS. For DOT, the lead agency responsible for addressing the NDAA directives is the FAA. The NDAA specifically requires that the plan include:

- A description of how the DoD and DOT will communicate and cooperate, at the executive management and action levels, to provide expanded access to the national airspace for unmanned aircraft systems of the DoD.
- Specific milestones, taking into account the operational and training needs of the Department of Defense and the safety and air traffic management needs of the Department of Transportation, for providing expanded access to the national airspace for unmanned aircraft systems and a transition plan for sites programmed to be activated as unmanned aerial system sites during fiscal years 2010 through 2015.
- Recommendations for policies with respect to use of the NAS, flight standards, and operating procedures that should be implemented by the DoD and the DOT to accommodate UAS assigned to any State or territory of the United States.
- Identification of resources required by the DoD and the DOT to execute the plan.

In response to these NDAA provisions, the NAS Access Plan defines a structured process, recommendations and milestones by which the needs and challenges of ExCom member organizations can be identified, considered, and addressed in a manner that effectively utilizes the government's collective resources. Though section 935 direction focuses on the near-term 2010-2015 milestones, the NAS Access Plan considers a broader scope that also addresses mid- and long-term objectives. This approach ensures addressing the broader UAS community goal of expanded access to the NAS.

1.1 Purpose

This NAS Access Plan is intended to establish a set of recommendations focused on addressing NAS access needs through the assessment of policies, regulations, standards, and technologies that intend to enable more routine NAS access for public UAS missions.

[3] National Defense Authorization Act for Fiscal Year 2009, Public Law 110-417, October 14, 2008, Section 1036, "Sense of Congress on Joint Department of Defense-Federal Aviation Administration Executive Committee on Conflict and Dispute Resolution."

This Plan will result in the development of executable actions that will include definition of resources, strategies, project milestones, and products that will be used to substantiate the safe expansion of UAS operations within the NAS. This Plan provides the ExCom executives a basis to determine the commitment and efforts needed to be undertaken given available resources and urgency of operational needs.

1.2 Background

In recent years, the number of requests made to the FAA to fly UAS in the NAS has risen significantly. Awareness of UAS capabilities and benefits has contributed to an increased demand by government and state organizations. This potential benefit has driven the requests for UAS operations to increase over 900% since 2004. As a result, the FAA adapted an existing regulatory waiver process to address the requests and to focus agency resources without compromising the safety of the NAS. Currently, federal public UAS operations conducted outside of Restricted and Warning Areas are approved through a Certificate of Waiver or Authorization (COA) from the FAA.

One effort to streamline NAS access for DoD UAS operations is outlined in the National DoD-FAA Memorandum of Agreement, dated Sept 27, 2007, for "Operation of Department of Defense Unmanned Aircraft Systems in the National Airspace System".

The increasing demand for UAS operations in the NAS is outlined for each agency as follows:

DoD: UAS have become a critical component of military operations, flying over 450,000 flight hours in 2009 supporting both Operations Enduring Freedom and Iraqi Freedom, exclusive of hand-launched systems. Future operations and training flight hour projections predict exponential growth expectations (See Figure 1). The DoD currently has 146 UAS units based at 63 continental United States (CONUS) locations. By 2015, the Joint UAS Center of Excellence (JUAS COE) estimates the DoD will have 197 units at 105 locations - a 35% increase in units and 67% increase in number of locations (See Figure 2).[4]

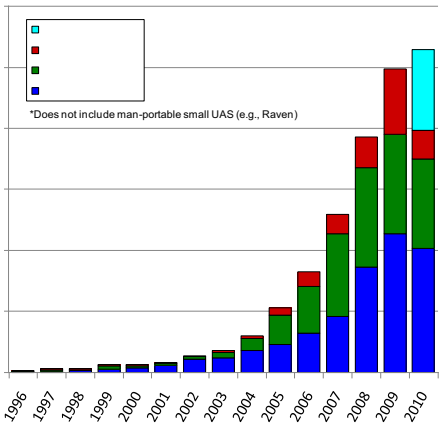


Figure 1: Worldwide DoD UAS Operations and Training

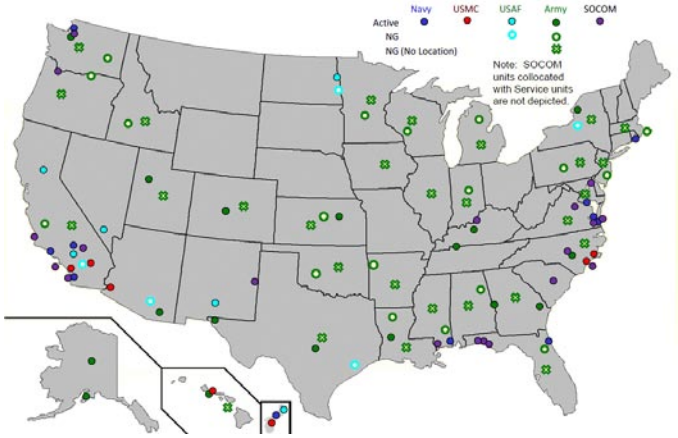


Figure 2: Planned DoD 2015 UAS Locations

[4] Joint Unmanned Systems Center of Excellence, *National Airspace Integration*, March 2010

DHS and NASA: DHS and NASA also have an increasing demand for UAS operations. NASA intends to continue to utilize UAS for a variety of science and aeronautical research missions including atmospheric sampling, monitoring forest fires (in partnership with the U.S. Forest Service and other agencies), synthetic aperture radar imaging of Arctic, Atlantic, and Pacific oceans, and hurricane reconnaissance.

UAS are beginning to take an active role in homeland defense, homeland security, defense support to civilian authorities and other domestic operations. DHS requires NAS access at several locations around the country as well as in the Gulf of Mexico. Currently, DHS operates and is expanding operations of Predator UAS along the southwest border with Mexico and the northern border with Canada. Additionally, DHS supports humanitarian missions such as Federal Emergency Management Agency (FEMA) flood support to the 2009 flooding disaster in North Dakota and Minnesota. Further, DHS recently developed a Maritime Predator-B variant, based in Florida and jointly operated by Customs and Border Protection and the Coast Guard, to monitor illegal immigration and drug trafficking in the Gulf of Mexico (see Figure 3).

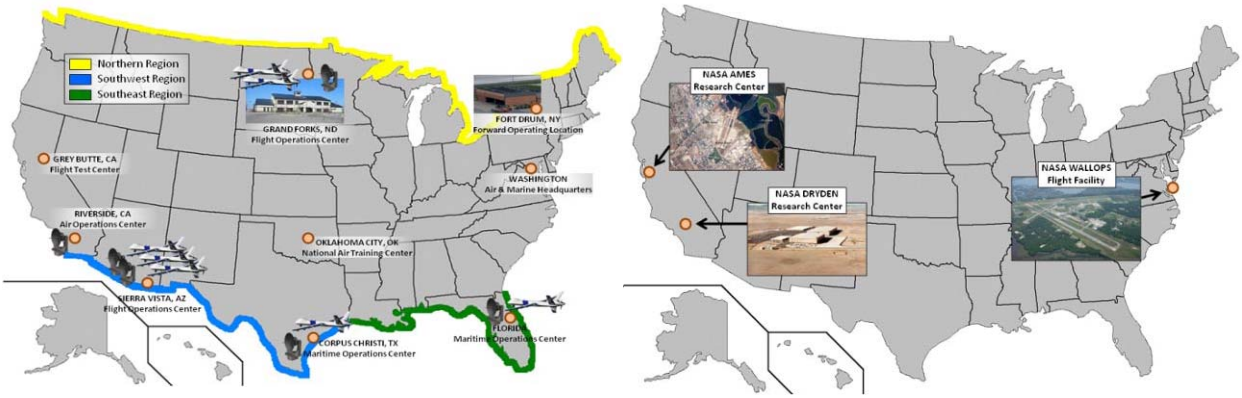
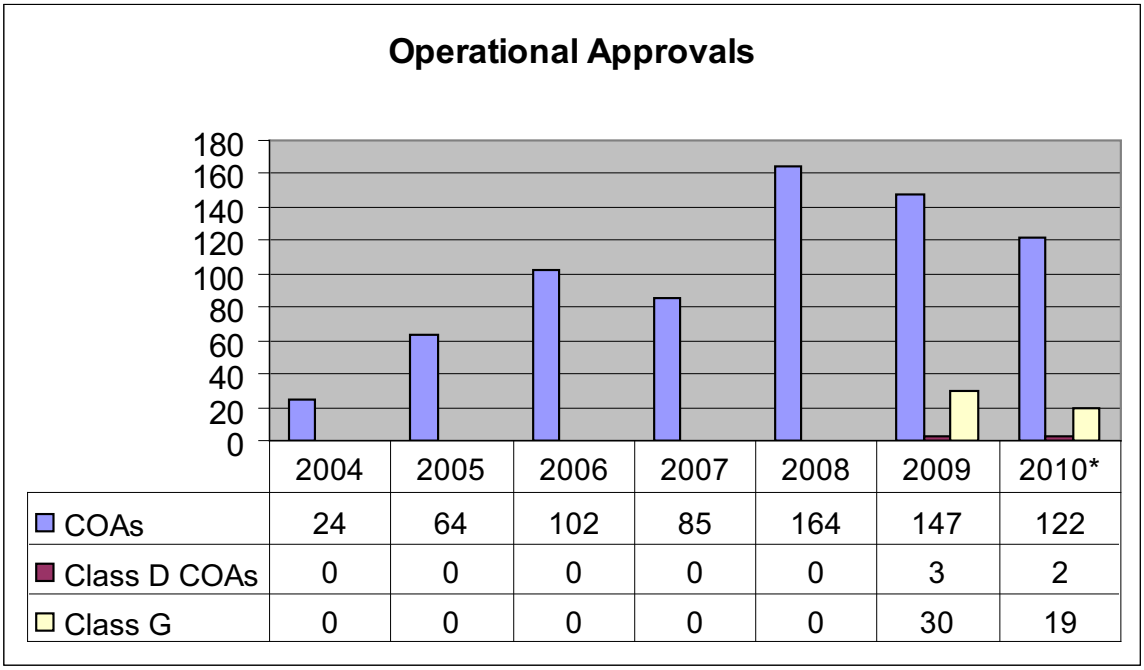


Figure 3: DHS, CBP and NASA UAS Operating Locations

FAA:
Figure 4 depicts the locations and number of approvals issued by the FAA since 2008.

Figure 4: Locations of Approved COAs and Class D Operations. Some locations have multiple approved COAs.



	2004	2005	2006	2007	2008	2009	2010*
COAs	24	64	102	85	164	147	122
Class D COAs	0	0	0	0	0	3	2
Class G	0	0	0	0	0	30	19

* Represents current Operational Approvals as of June 30th, 2010

Figure 5. Operational Approvals

FAA understands the importance of working toward global harmonization of UAS operations and, to that end, has partnered with national and international groups focused on UAS safety, standards and integration to include industry and other government agencies. Groups the FAA actively works with to consider the integration of UAS include:

- RTCA for development of civil UAS standards
- EuroCAE for the development of European UAS certification standards
- International Civil Aviation Organization (ICAO)Study Group
- EUROCONTROL
- The University of New Mexico under a Cooperative Research and Development Agreement (CRDA)
- AAI Corporation, GE Aviation, and General Atomics-Aeronautical Systems Inc. under Cooperative Research Development Agreements (CRDA)

1.3 Scope

FEDERAL PUBLIC UAS

Although section 935 of the NDAA for FY 2010 requires only that DoD and DOT, in consultaton with DHS, developed a plan to expand UAS Access for DoD systems, this plan addresses access to the NAS by other Federal public UAS, as well as by DoD. As operators of Federal public UAS, DHS and NASA have been invited to participate in the ExCom and provided valuable insight into this report. Even as this report provides milestones specifically for Federal public UAS, many of the outcomes that result from this effort may be applicable to non-Federal public and civil UAS.

The ability for civil UAS to utilize the solutions identified in this Plan hinge upon FAA regulatory guidance as the FAA has certification authority for civil aircraft, personnel, and operations. ExCom members will assist the FAA with developing regulations through providing UAS safety data and advocating improvements to policy, procedures and technology.

TECHNOLOGY, POLICY, PROCEDURES, AND STANDARDS

Section 935(b)(3) of the 2010 NDAA specifically requests recommendations for policies, flight standards, and operating procedures. In addition to these recommendations, many airspace integration solutions can be achieved through enabling technologies. Therefore, this Plan outlines a process to establish recommendations for technology, policy, operating procedures, and standards.

Foundational Requirements

For any aircraft – manned or unmanned – to fly routinely in the NAS, three foundational requirements must be met:

- The aircraft must be certified as airworthy
- The pilot in command must be qualified to fly in the appropriate class(es) of airspace
- The flight operations must be in compliance with applicable regulatory guidance

All three requirements are essential and form the foundation for UAS airspace integration. As operators of Federal public aircraft, the DoD, DHS and NASA are responsible for the certification both of their aircraft and aircrew. The third requirement, regulatory compliance, encompasses both military and FAA flight regulations. The DoD follows its own flight regulations as well as specific FAA federal aviation regulations (FARs) and rules. All are essential for UAS to safely integrate into the appropriate class within the NAS.

TIMEFRAMES

To allow timely expansion of NAS access while working towards viable long-term solutions, ExCom members are utilizing a phased approach that focuses on near-, mid-, and far-term timeframes.

- Near-term activities will address high priority mission needs, as identified by ExCom members. These activities will include consideration of technologies, procedures, and a safety and regulatory framework.

- Mid-term activities will focus on validating the safety and regulatory baseline established as part of the near-term activities. They will also seek to validate a set of standards that enable compliance with existing FARs and conform to existing air traffic control (ATC) standard operating procedures.

- Far-term activities include unmanned aircraft certification and operating standards to permit routine NAS access without impact to NAS safety and efficiency. Far-term activities should address UAS missions in all desired operational environments and airspace. These activities include developing, certifying, and fielding UAS enabling technologies to approved technical standards and performance specifications.

2 APPROACH AND METHODOLOGY

This section defines an integrated and structured approach that considers the needs of the broader UAS community while initially focusing on critical needs of the ExCom members. The NAS Access Working Group (NAWG) will use this process to consider how best to accommodate UAS access to the NAS. The methodology described below represents a process in which individual agency needs are considered in the context of the overall UAS community's strategic approach to maximize the value of all Government efforts.

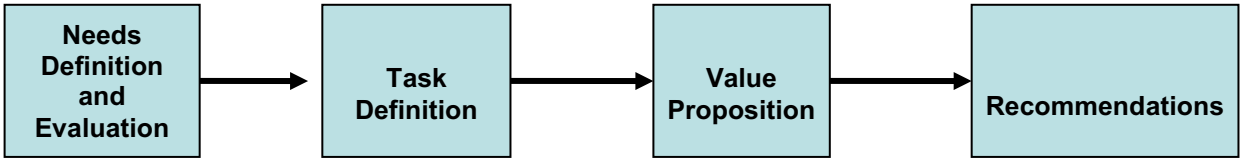


Figure 6. ExCom Process

2.1 Needs Definition and Evaluation

Each of the ExCom member organizations should conduct a detailed shortfall analysis that identifies, defines, and prioritizes their operational needs. This should be accomplished in a manner allowing for comparison among the agencies and grouping of needs by like characteristics. Identifying common needs will provide for broader consideration across organizations and enable the development of joint solutions and activities that meet the needs of multiple agencies.

Each organization should evaluate their stated needs with consideration for:

- Realistic and economic alternative solutions to the address stated needs,
- Preliminary program requirements,
- Project resource estimates for executing tasks efforts, and
- Value of satisfying stated needs
- Challenges to satisfying stated needs

This evaluation will establish a basis for estimating program costs and benefits during later steps in the process and will be considered during decision-making processes when establishing solutions to meet mission needs.

The DoD has assessed and characterized its mission needs and presented them in the Department's UAS Airspace Integration Plan. Sections of the DoD plan will serve as inputs into the ExCom needs definition and evaluation process.

DHS and NASA have reviewed the DoD needs and view them as a beneficial complement to their individual organization needs.

Before defining tasks that address organizational access needs, associated barriers must first be identified and traced back to individual needs. These barriers to meeting organizational needs must be overcome through tasks defined and proposed through the following steps.

2.2 Task Definition

The first step in defining tasks, which will address organizational needs, should be accomplished by providing operational concepts detailing both the present “As-Is” state and the future “To-Be” state. The latter should provide the vision of how UAS operations would be supported if the agency needs were met. These detailed descriptions are imperative to task managers when establishing traceability to the original need and potential barriers encountered. It should provide performance metrics to determine the state of progress and, ultimately, completion of the task. Task definition should focus on bridging the gaps between the present and future states. Coverage analysis is necessary to identify any discrepancies in needs definition (e.g. conflicting needs among organizations), and to ensure that proposed tasks meet identified needs without imposing additional needs. Current efforts underway within the UAS community must be reviewed for potential applications that could satisfy specific needs. Leveraging these efforts could shorten the overall timeline to achieving satisfactory results. ExCom members will have the ability to partner and utilize finite resources in the most effective and efficient manner possible.

The task definition consists of establishing specific activities to address identified needs. These tasks may include, but are not limited to, regulatory review, policy review, standards review, research efforts, demonstrations, technical prototyping, modeling and simulation. The task definition activity will result in project plans that sufficiently address, as appropriate:

- Cost
- Expertise, equipment, and other resources required
- Outcomes and products, and how they will be used
- Definition of success
- Risks
- Timelines
- Milestones
- Metrics

Alternative task areas will be defined based on needs, but also on the feasibility and economic factors that tie directly to individual and collective needs. Both material and non-material alternatives will be evaluated during this process.

Key factors to consider are safety, operational cost efficiencies, technological maturity, and impact on the NAS. Alternatives should be qualitatively different from each other (e.g., different technologies such as ground-based versus airborne solutions). Low risk, cost-effective, and operationally suitable solutions are preferred. All concepts that emerge during this step will be considered provided they satisfy the correlated needs and can be achieved without unreasonably impacting safety and efficiency of existing NAS operations. This is established by the organization originating the solution and is verified and accepted by the FAA prior to integrated use. Key functional disciplines such as safety, security, and human factors will be required to participate in the activities of concept and requirements definition in order to determine mandatory requirements and evaluate their impact on potential alternative solutions.

All solutions that require resources from more than one of the member organizations will be submitted for consideration and disposition.

2.3 Value Proposition

The value proposition step will evaluate the relative benefit of achieving a given task compared to other tasks. The desired outcome of individual tasks will determine the relative value of undertaking each task. This will provide clear metrics for each task under consideration and will trace directly to the needs. Given resource constraints, this assessment will prove key in maximizing value across ExCom member organizations.

2.4 Recommendations

This step involves formulating a set of recommendations to the appropriate management level within ExCom for sponsorship and execution. The recommendations must take into consideration the alternative analyses and criticality of recommended approach and must include an executive summary with required resources, timelines and risks.

As a result of the needs identification and task definition processes, it may be necessary to employ research by other agencies or industry to define operational concepts, develop a set of preliminary requirements, demonstrate and refine technologies, reduce risk, or achieve consensus on potential solutions.

3 EXCOM AGENCY UAS NEEDS

Organizational NAS access needs are described in the following section. DoD subdivides its needs into Operational, Defense Support to Civil Authorities (DSCA),Training, Research and Development (R&D), and testing missions. DHS needs are separated by Maritime Surveillance, Border Surveillance, Disaster Relief, and Training and Testing. NASA classifies its needs as Scientific. FAA needs are focused on data collection, validation of existing, or the development of new, regulations, policy, guidance material, and procedures for UAS.

3.1 Department of Defense (DoD) UAS Needs

To maintain a high degree of combat readiness, the Military Departments and appropriate COCOMs need to conduct realistic UAS and integrated training (i.e. manned-unmanned teaming) in the NAS prior to operational missions. For each UAS, the Military Departments and COCOMs establish pilot, crewmember, and maintainer training and readiness requirements, necessitating training missions for initial qualification and to maintain proficiency. These missions seek to emulate as closely as possible real world conditions, so as to “train like you fight” and maintain readiness. To meet these training requirements, Military Departments and COCOMs must maintain proficiency in areas such as line-of-sight operations, launch/recovery operations, orbit operations, ground target tracking operations, and night operations. Missions need to be conducted day or night, at joint-use airfields, and in multiple types and classes of airspace.

The DoD needs to be able to respond rapidly to operational tasking, typically from a COCOM such as the United States Northern Command (NORTHCOM). Many of these tasked missions relate to homeland defense, homeland security, and defense support to civilian authorities. This includes border and port surveillance, maritime operations, counter-drug operations, and disaster or special event support.

It is important to note that DoD UAS place high value on the ability to operate freely within Special Use Airspace (SUA). To support these operations, there is an associated requirement to transit to/from those areas for DoD UAS.

The DoD needs to conduct research and development of existing and future UAS technologies and systems to stay at the forefront of technological advances that enhance current UAS mission effectiveness and enable new UAS applications. The DoD also needs to maintain, modify, and test its growing inventory of UAS.

Small UAS are expected to consume the majority of total UAS flight hours. Thus, most of the agency needs will include small UAS elements and unique considerations.

Table 1: Examples of DoD UAS Needs

High-Level Need	Operational Need	UAS	Operating Parameters
Operational Missions	Reconnaissance / Surveillance	Medium and High Altitude – Long Endurance	• Vast geographical regions • SUA / MOA • Joint-use airfield
	Low- to Mid-Altitude Ground Target Tracking	All	• SUA / MOA • Day / Night
	Aircraft and Payload Systems Support	All	
Training	Data-link Line-of-Sight (LOS) Operations Training	Small and Medium UAS	• Horizontal radius of approx 100 nm[5] • Day / Night
	Launch / Recovery Training	Small and Medium UAS	• Day / Night
		Medium and High Altitude – Long Endurance	• Day / Night • Joint-use Airfield
	Orbit Operations Training	Medium and High Altitude – Long Endurance	• SUA / MOA
R&D	All	All	• SUA / MOA • Day / Night • Joint-use airfield
Maintenance & Testing	All	All	• SUA / MOA • Day / Night • Joint-use airfield

** The operating parameters in this table are examples of operational needs*

3.2 Department of Homeland Security (DHS) UAS Needs

Securing the nation's land and maritime borders are two of the most challenging and important roles of government. DHS, through Customs and Border Protection (CBP) and the Coast Guard, needs to operate UAS in the NAS to effectively accomplish persistent border and maritime surveillance to detect, interdict and prevent acts of terrorism and the unlawful movement of people, illegal drugs and other contraband toward or across the borders of the United States. The U.S. maritime and land borders present attractive avenues for entering illegally, conducting terrorist attacks, trafficking contraband, or committing other criminal activities. As the United States improves control over its land borders through a variety of CBP programs and initiatives, the nation's expansive maritime borders of relatively open ports and coastlines could become a less risky alternative for bringing people and materials into the country illegally. Key to an effective, layered system of border controls, then, is balance and coverage across the land and maritime domains, including the integrated and aggressive use of

[5] JUAS COE Briefing for R&E IPT, 07Jul 09

UAS. Other UAS applications for DHS involve disaster relief, training of crews, and testing of systems and payloads.

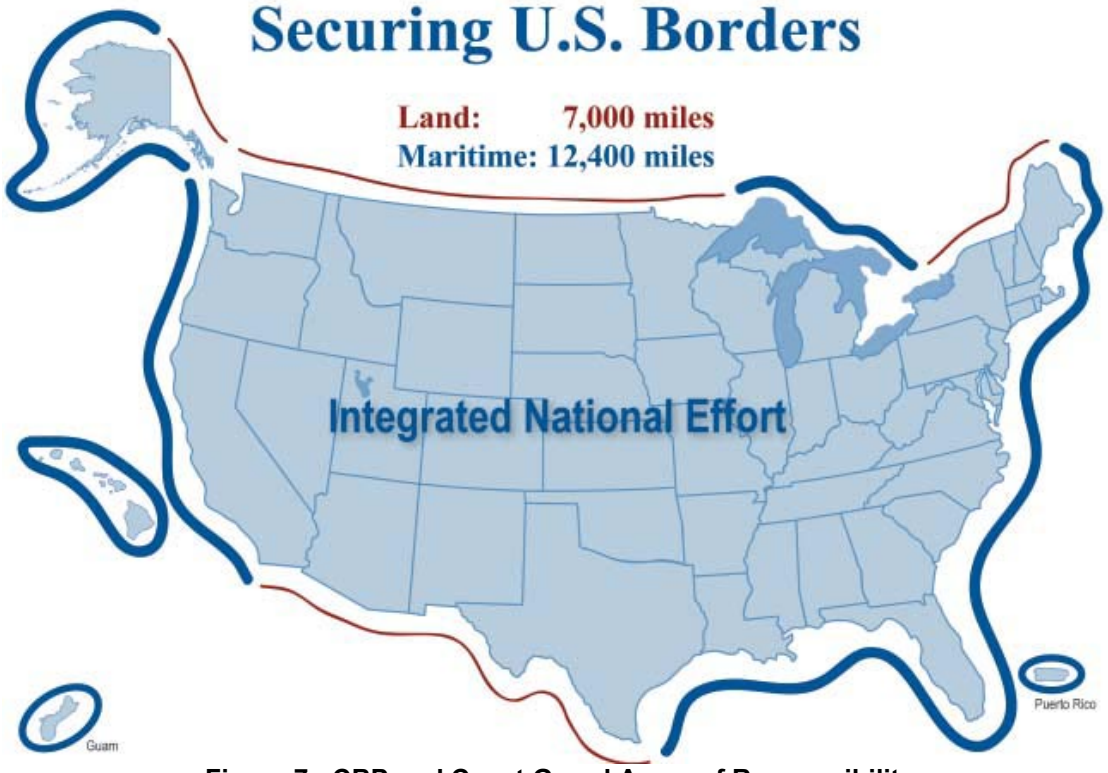


Figure 7: CBP and Coast Guard Areas of Responsibility

LAND BORDER SURVEILLANCE

DHS needs to monitor the Nation's land borders to the south and north. Sierra Vista, AZ will host CBP UAS operations for the southwest border while Grand Forks, ND and Ft. Drum, NY will provide the bases for northern border surveillance. Other sites in Texas and Florida are planned to host UAS border and maritime surveillance activities around the Gulf of Mexico and Caribbean in the near future.

MARITIME SURVEILLANCE

As the nation's lead agency for maritime security, the Coast Guard[6] delivers value to the public through its 11 statutory missions.[7] The Coast Guard is evaluating the application of UAS technology to enhance the execution of statutory requirements and help meet mission performance goals such as reduction in maritime crime, security of maritime borders, and

[6] The Coast Guard is defined by Titles 10 and 14 as one of the five Armed Forces of the United States and the only Armed Force with law enforcement authority as codified in Title 14.

[7] The Coast Guard's eleven statutory missions include: Search and Rescue, Marine Safety, Aids to Navigation, Ice Operations, Marine Environmental Protection, Living Marine Resources, Drug Interdiction, Migrant Interdiction, Other Law Enforcement, Ports, Waterways, and Coastal Security, and Defense Readiness.

protection of maritime infrastructure.[8] UAS, with its ability to provide persistent maritime surveillance in challenging operational environments, is intended to support DHS priorities, including the Coast Guard's three maritime security objectives:

- Achieve Maritime Domain Awareness (MDA)
- Establish and lead a Maritime Security Regime
- Deploy effective and integrated operational capability

To achieve these security objectives, the Coast Guard intends to employ both cutter-based and land-based UAS to alleviate maritime patrol hour gaps by providing persistent wide-area surveillance and MDA of littoral waters and the high seas.

Two Mission Analysis Reports[9] (MAR) indicated significant gaps in surveillance coverage in their respective regions. Despite the age of the MARs, the analysis behind them remains valid and the gaps they identified exist today. First, while Coast Guard aircraft are currently able to perform assigned missions, fundamental upgrades to Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) capabilities are needed to meet threats and demands – this is a capability gap. Secondly, the aforementioned studies find that insufficient aircraft flight hours are available to meet post- September 11, 2001 mission demands – this is the availability gap. Together, these gaps impact United States MDA and, more specifically, every Coast Guard mission that relies on airborne ISR.

MDA is collected during the conduct of all Coast Guard missions and means the effective understanding of anything associated with the maritime domain that could impact the security, safety, economy, or environment of the U.S. The execution of these complimentary missions ensures the maritime domain is safe and secure, and that care is taken to protect the marine environment.

The Homeland Security Act of 2002 divided the Coast Guard's eleven statutory missions between homeland security and non-homeland security. Reflecting the

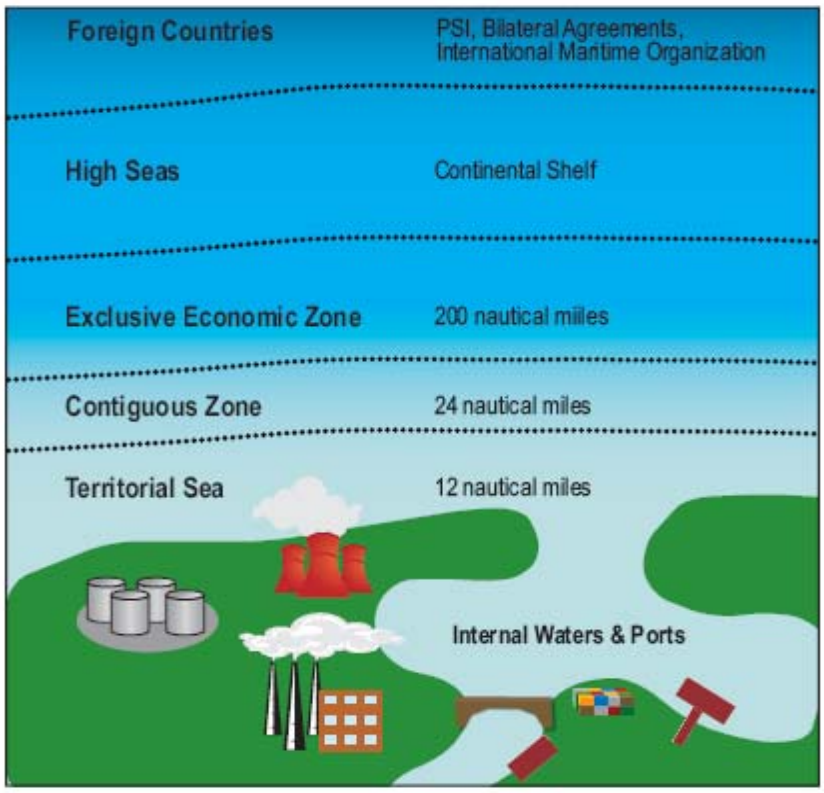


Figure 8. Maritime Zones as They Expand Out From Land

[8] In February 2009, the DHS Deputy Secretary approved the Coast Guard's UAS Strategy of acquiring both cutter and land-based UAS.

[9] Deepwater Mission Analysis Report, 06 November 1995 and Coastal Zone Mission Analysis Report, June 1999.

Coast Guard's historical role in defending our nation, the Act delineated Ports, Waterways and Coastal Security (PWCS) as the first homeland security mission. The Commandant of the Coast Guard designated PWCS as the service's primary focus alongside search and rescue. Achieving and maintaining a high level of MDA allows maritime authorities like the Coast Guard to better apply their resources at sea.

The Maritime Domain encompasses all areas and things on, under, relating to, adjacent to, or bordering on a sea, ocean, or other navigable waterway. The Maritime Domain includes all maritime-related activities, infrastructure, cargo, and vessels and other means of water transport. Practically, ensuring the safety, security, and environmental stewardship of the Maritime Domain requires protection of the Nation's 25,000 miles of waterways, 12,000 miles of inland waterways, and 95,000 miles of coastline comprising the U.S. Marine Transportation System.

Attaining and sustaining an effective understanding and awareness of the maritime domain requires the timely collection, fusion, analysis, and dissemination of prioritized categories of data, information, and intelligence. To achieve and maintain MDA, the Coast Guard will require prompt UAS access to airspace over the Pacific, Atlantic, Caribbean, and Gulf of Mexico, including access to U.S.-managed Flight Information Regions.

While Coast Guard missions requiring the use of UAS will initially be conducted in the offshore environment in international airspace where due regard for other aircraft will be observed, Coast Guard UAS will need the authority and/or capability to transit the NAS to international airspace. As technology sufficiently advances and other barriers to the NAS are adequately addressed, achieving and maintaining MDA may require the Coast Guard to operate UAS in and around our Nation's ports and waterways, inland river system, and within the territorial seas as defined by 12 nautical miles from shore.[10]

DISASTER RELIEF

It is the intent of Congress, by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, to provide an orderly and continuing means of assistance by the Federal Government to State and local governments in carrying out their responsibilities to alleviate the suffering and damage, resulting from an emergency or disaster. Further, it is the purpose of Homeland Security Presidential Directive 5 to enhance the ability of the United States to manage domestic incidents by establishing a single, comprehensive national incident management system. This management system is designed to cover the prevention, preparation, response, and recovery from terrorist attacks, major disasters, and other emergencies.

The airborne persistence and suite of sensors and radars that characterize UAS bring added capabilities to disaster and emergency assistance. DHS employs UAS for situational awareness, critical infrastructure assessment, and emergency response to aid planners and leadership on how best to employ resources to stem suffering and damage. Recent examples include the 2009 river flooding in North Dakota and Minnesota and the 2010 Mississippi Canyon oil spill in the Gulf of Mexico. In both instances, it was determined that the disasters were of such severity and magnitude that effective response was beyond the capabilities of the State and the affected local governments and that Federal assistance was necessary. In both incidents, DHS employed UAS to provide aerial imagery to help assess flooding/oil extent and concentration.

[10] The NAS extends to 12nm from shore. Beyond 12nm is considered international airspace governed by ICAO.

TRAINING AND TESTING

To ensure UAS aircrews are adequately trained to respond 24/7 to real-world missions in challenging environmental conditions, DHS will need to perform day and nighttime training missions and operational exercises in the same airspace in which they may be called upon to conduct operations. Further, DHS UAS will likely need to transit the NAS to and from aviation training centers, flight and maritime operations centers, and forward operating locations. There is also a need for DHS to operationally test and evaluate UAS, including the payloads (e.g., sensors, radars, etc.) they carry.

Table 2: Examples of DHS UAS Needs

High-Level Need	Geographic Area
Border Surveillance	Southwest Border
	Northwest Border
	Northeast Border
Maritime Surveillance	Pacific Ocean
	Atlantic Ocean
	Gulf of Mexico
	Caribbean Sea
	Bering Sea
	Inland River System
	Ports, Waterways and Coastal Areas
Disaster Relief	Any State of the U.S.
	Coastal and Offshore Environments
Training & Testing	Same as DoD training needs

3.3 National Aeronautics and Space Administration (NASA) UAS Needs

NASA airspace access needs stem primarily from the agency's mission to understand earth system processes using global satellite observations and models. In addition to it's science needs, NASA has increasingly turned to UAS to satisfy aeronautical research mission objectives. NASA operates Global Hawk, Predator B, and a number of medium to small UAS for these purposes.

SCIENTIFIC MISSIONS

NASA's greatest need for NAS access comes from the agency's focus on scientific missions. Measurements from aircraft are critical at all stages of mission development, from instrument testbedding to data product development and validations. UAS provide improved range and endurance, enabling new measurements. Examples of science missions include very high and very low atmospheric sampling, hurricane science, and Earth surface measurements. These missions expand from over U.S. homeland to the far reaches of the Pacific and to both North and South Poles. The airspace may be low, high or over populated areas. The airspace may be required for rapid response to mission requirements.

NASA requires flexible access to the NAS to support measurements of the globe's changing environment. NASA has been requested to participate in natural disaster relief operations on short notice, most recently to support wildfire operations in the Western U.S. using the NASA Ikhana (Predator-B). Most missions evolve from 6-12 months before launch, so some airspace can be pre-determined for some missions such as arctic ice measurements.

Operation of the NASA Global Hawk requires transit corridors to the east coast for hurricane research and in support of NOAA operations.

In addition to scientific missions, NASA has increasingly relied on small UAS to conduct aeronautical research due to cost advantages over larger systems in testing new avionics or designs. In addition, small and medium UAS are used for hurricane research and atmospheric sampling.

Table 3: Examples of NASA UAS Needs

Operational Need	UAS	Operating Parameters
Scientific Missions	Small and Medium Size UAS	• 1,500-12,000 ft • Flight over populated and unpopulated landmasses and the globes oceans
	Medium Altitude Long Endurance	• Horizontal transit at 23k ft • 10k-18k ft for high-res data • Rapid response
	High Altitude Long Endurance	• Long endurance flights across vast geographical regions

* The *operating parameters in this table are examples of concepts of operations.*

3.4 Federal Aviation Administration (FAA) UAS Needs

The FAA is responsible for developing policy, guidance material, and standards for the existing National Airspace System (NAS) and the future Next Generation Air Transportation System (NextGen). This includes the UAS civil certification basis and operational procedure development to ensure the safe integration of UAS into the NAS. While existing safety and aviation standards address manned aircraft, unmanned aircraft have challenges demonstrating compliance to those standards, and, in some cases, the appropriate standards do not exist. In certain cases, metrics to measure UAS performance relative to manned aircraft have not yet been identified.

Development of standards, certification approaches, policies, and procedures to support mixed-use operation of manned and unmanned aircraft while maintaining safety in the NAS presents a challenge.

Safety Needs

FAA goals are to define appropriate levels of safety with corresponding performance characteristics and procedures for UAS operations that do not adversely impact existing levels of NAS safety, airspace efficiency, and the Air Traffic Control (ATC) system, yet are achievable considering the products of the ExCom activities. Examples of specific needs include:

- Safeguard the security of ATC spectrum throughout the NAS as interfaces with UAS are introduced.
- Procedures and performance levels to exchange voice and data communication messages between UAS operators and air traffic controllers commensurate with manned aircraft.
- Funding and resources to support ongoing UAS research, development, modeling and simulation, safety analysis, and integration initiatives.
- Training material, programs, and techniques for all FAA impacted lines of business supporting UAS integration in the NAS.

Regulatory, Policy and Standards Needs

FAA goals are to develop standards, policy, regulations, and guidance material for UAS without negatively impacting manned aircraft and the strategic operation of the NAS. Examples of specific needs include:

- Sense and Avoid (SAA) standards and policy commensurate with manned aircraft operations.
- Standards and policies that enable UAS to comply with ATC clearances and instructions commensurate with manned aircraft.
- Air traffic control airspace management standards and policies that enable the integration of UAS without segregation.
- Control and communication performance standards and procedures with policy and guidance material to enable certification of public, civil- and commercial-use UAS operations.
- UAS navigation, type and performance standards that conform with ATC flight planning, traffic management, and automation systems.
- Standards for control stations, recovery systems, automated take-off and landing systems, and rotorcraft that can safely and effectively support integrated operations.

Operational and Procedural Needs

FAA's goal is to identify operational integration challenges and develop appropriate ATC procedures where necessary. Examples of specific needs include:

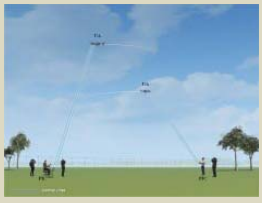
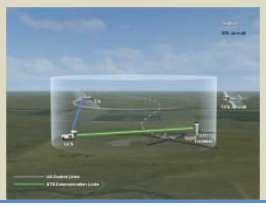
- The interoperability of UAS is proven to be safe and manageable while minimizing the impacts to NAS users and keeping the exisiting and NextGen Air Traffic System Management Plan efficient.
- UAS performance metrics to verify the ability of unmanned aircraft to comply with operational rules, ATC procedures, and policies.
- Operational standards that maintain or enhance current levels of airspace efficiency for NAS operations and NexGen solutions.
- ATC standards and UAS wake vortex and turbulence avoidance criteria with corresponding algorithms.

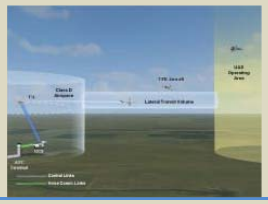
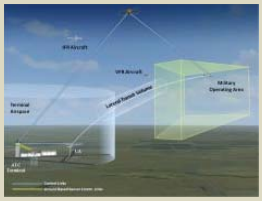
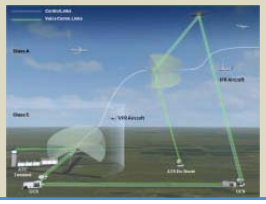
3.5 Common UAS Access Needs

Each organization has identified individual NAS access needs that are critical to meeting organizational missions. These needs can be generalized and compiled into achievable specific mission categories that are common across organizational lines:

- *Airspace*—DHS, NASA and DoD have illustrated a need for greater access to airspace to support agency missions. Because the FAA regulates aircraft operations in the airspace, it has the need to ensure the safety of these operations without unduly impacting system efficiency.
- *Operations*—Table 4 represents operational needs aligned with proposed categories.

Table 4: Common UAS Access Needs

DEPT / AGENCY	REPRESENTATIVE MISSION NEEDS	PROPOSED ACCESS PROFILES
DoD / DHS / NASA	• Training • Development & Test • Maintenance & Checkout	**Line of Sight** 
DoD	• Tactical Surveillance & Reconnaissance • Pilot / Operator Qualification Proficiency	
DHS	• Border / Maritime Surveillance	
NASA	• Aeronautical Research	
DoD / DHS / NASA	• Training • Take-off / Landing Proficiency • Disaster Relief	**Terminal Area** 
DoD / DHS	• Surveillance & Reconnaissance • Aircraft and Payload Systems Testing	
DHS	• Border / Maritime Surveillance	

DoD / DHS / NASA	• Aircraft Deployment and Ferry	**Lateral Transit** 
DoD / DHS	• Transit to Training Airspace	
DHS	• Border / Martime Surveillance	
NASA	• Aeronautical Research	
DoD / DHS / NASA	• Aircraft Deployment and Ferry • IFR Qualification & Proficiency	**Vertical Transit** 
DoD	• Orbit Operations	
DHS	• Border / Maritime Surveillance	
NASA	• Aeronautical Research	
DoD / DHS / NASA	• Research and Development	**MOA** 
DoD / DHS	• Training • Testing	
DHS	• Maritime Surveillance	
NASA	• Aeronautical Research	
All	• Operational Missions • Training Missions • Support Missions • Scientific Missions	**Dynamic** 

- *Research and Development (R&D)*—As UAS standards and system requirements continue to evolve, R&D will be needed to evaluate and validate potential solutions and their impacts on the NAS. Cooperative agreements with industry and inter-government agency agreements for shared resources may be a benefit to all stakeholders.

- *Standards*—The development of standards for UAS flight technologies, system performance, system reliability, and operational procedures is a common element that is beneficial to all UAS stakeholders. Standards ensure safety, predictability, and inter-operability and streamline the development of systems.

- *Training*—Mission success depends on pilots, flight crews, maintainers, and air traffic personnel receiving comprehensive training on real-world situations in realistic environments. There is a need for the development of training requirements and/or personnel qualifications to be established that ensure the safe operation of UAS in the NAS.

- *Policy & Regulation*—These common needs all have policy and regulation elements that must be considered and addressed as appropriate to enable operations while maintaining NAS safety without the need for waiver or exemption.

Collaboration across organizations to satisfy these common needs will enhance each agency's ability to meet its individual mission needs.

4 CHALLENGES TO EXPANDED NAS ACCESS

One of the major challenges for airspace integration is the inability of UAS to comply with regulatory requirements, not only because the majority of regulatory requirements did not consider UAS when they were created, but also because most UAS are not able to comply with certain regulations. These challenges are identified as regulatory, procedural, technical, and standards.

4.1 Regulatory Challenges

Operators of UAS in the NAS must adhere to required FAA regulations contained in Title 14 of the Code of Federal Regulations (14 CFR). The absence of an onboard pilot poses new challenges in determining appropriateness and completeness of existing regulations. For example, the current regulations require that a pilot must maintain vigilance to see and avoid other aircraft. Until the necessary UAS-specific standards, regulations, and agreed-upon compliance methodologies are defined, it is difficult to establish regulatory compliance for more routine operations.

4.2 Operational and Procedural Challenges

Current operational rules for airspace and aircraft are based on the existing NAS safety architecture of dependability standards, system predictability, real-time response capabilities and safety to the public in the air and on the ground. It will be necessary to develop appropriate and specific UAS operational procedures that address UAS unique behavior and responses (e.g., lost-link, compliance with visual ATC clearances, real-time response capabilities and wake turbulence standards.) Operating procedures need to be established so that UAS perform in a predictable manner, thereby allowing missions to be accomplished while maintaining the safety of the NAS. These procedures need to be understood by both the pilot and air traffic controller.

The existing ATC system is based on timely responses and compliance with instructions. Performance measures need to be established regarding UAS interoperability with air traffic services.

4.3 Technical Challenges

The fundamental principle for flying a UAS is a pilot's ability to control an aircraft from a location that is not on-board the aircraft. UAS operations must consider interoperability with ATC communication architectures to ensure the appropriate technical equipment and procedures are in place to accommodate airspace usage requirements.

UAS must meet the minimum equipage and performance requirements for each class of airspace as codified in Title 14 of the Code of Federal Regulations. UAS currently face a challenge in demonstrating the appropriate functionality and performance level of installed equipment.

4.4 Standards

Standards need to be established and substantiated to provide UAS with an appropriate level of safety necessary for the class of airspace and type of aircraft being flown. A detailed

assessment of performance and technical standards is needed to establish a high level of confidence in the results.

UAS operations in the NAS must be conducted in a manner consistent with the safety standards established by the FAA. The fundamental safety requirement for manned and unmanned aircraft, alike, is to provide an acceptable level of safety for people and property in the air and on the ground. To achieve this, there are two precepts that should be followed:

- UAS must operate safely, efficiently and compatibly with manned aircraft operations in the airspace so that the overall safety of the airspace is not degraded or compromised.
- UAS must pose no greater risk to persons or property in the air or on the ground than that presented by manned aircraft.

5 ANALYSIS

Today, UAS access to the NAS is based on the existing regulation, standards, and technologies outlined below. However, this is not sufficient to address Federal public needs for future access to the NAS. The future requirements to meet these needs are also identified in this section. A sample side-by-side comparison of existing versus future basis for access is presented in Table 5.

Table 5: Existing and Future Basis for Access

Existing Basis for Access	Future Basis for Access
Regulations, Policy & Procedures • 14 CFR, Part 91 • FAA Order 7610.4N • FAA Order 7110.65 • 2007 DoD-FAA MoA • FAA Guidance • Military Regulations and Operating Instructions • Certificate of Authorization or Waiver (COA)	Regulations, Policy & Procedures • Updated Policy and Guidance • Inter-Agency Agreements • Safety Case Methodology • Lost-Link procedures • Target Level of Safety • FAA Order 7110.65
Standards • Existing Standards (e.g. MIL-HDBK-516) • Pilot Standards • Military Specifications and Standards	Standards • Minimum Aviation System Performance Standards (MASPS) • Equipage • Update MIL-HDBK-516 UAS • Industry Standards (SAE, ASTM, RTCA)
Technology • Ground-based Radars • Equipment Qualification	Technology • NextGen Equipage Compliance • Frequency & Bandwidth • Sense and Avoid • Algorithms / Automation

5.1 Identify and Assess Existing Capabilities

REGULATIONS, POLICY and PROCEDURES

14 CFR: All UAS operating in the NAS must comply with applicable CFRs, including, but not limited to, 14 CFR, Part 91, General Operating Rules. Part 91 operating rules form the foundation for safe, predictable, and consistent operations in all classes of airspace for all types of aircraft, including UAS.

FAA Order 7610.4N: FAA Order 7610.4N - *Special Operations*, specifies procedures for air traffic control planning, coordination, and services during defense activities and special military operations within the NAS. The Order currently limits UAS operations to restricted areas or

warning areas, or allows operations outside those areas through the COA process. It outlines some of the procedures and equipment necessary to fly under a COA. The Order is updated regularly.

2007 DoD-FAA Memorandum of Agreement: This agreement allows certain DoD operations in specified airspace provided agreed upon conditions are met. It is noteworthy because it provides an opportunity for DoD to operate with less of an administrative burden while providing operational data to support UAS related activities.

FAA Interim Guidance: The latest guidance for UAS NAS access was published in March 2008 when the FAA published 08-01.[11] This document provides guidance specifically for the FAA Unmanned Aircraft Program Office (UAPO) and Unmanned Aircraft Systems Office (UASO) personnel to assess UAS flight operations in the NAS.

Certificate of Waiver/Authorization (COA): As identified earlier, public organizations currently conduct UAS operations outside of restricted or warning areas only under authorization from a COA. In limited cases, FAA has also permitted DoD UAS to operate under authorization agreement as outlined in the 2007 DoD-FAA UAS MoA. The COA process alone has produced 762 authorizations for UAS to fly at 75 locations throughout the country since 2004. The COA process is adequate for enabling a limited number of flights, but does not provide the level of airspace access necessary to accomplish all missions. While the long term goal is to provide the level of airspace access necessary to accomplish the wide range of missions possible with UAS, the COA process is currently necessary to maintain existing system safety.

STANDARDS

The development of standards for UAS flight technologies, minimum system performance requirements, system reliability, and operational procedures are critical to maintaining the safety of the NAS. The standards will provide guidance to manufacturers, flight operation organizations, pilots, regulators and certification specialists. Key UAS standard development areas include Control and Communication (C2), Sense and Avoid (SAA) and Ground Control Station (GCS) requirements. Standards development is dependent upon specific research and development, modeling and simulation, operational and test data.

FAA, DoD, and NASA are conducting research to develop UAS certification requirements and are collaborating with other government agencies and industry on development of appropriate standards.

Existing Operational and Technical Standards: UAS developers comply with both military and civil existing standards to the maximum extent possible. Airworthiness certification criteria, standards, and methods of compliance establish a minimum set of design and performance requirements for flying a given category and class of aircraft. UAS must follow existing operational and equipment standards for compliance with current regulations. Currently, there is a need to perform detailed analysis for unique systems to ensure safety compliance.

Pilot Standards: UAS pilot training and qualifications requires a different skill set than flying a manned aircraft due to differences such as the means of takeoff, cruising, and landing by visual

[11] FAA Aviation Safety Unmanned Aircraft Program Office AIR-160, *Unmanned Aircraft Systems Operations in the U.S. National Airspace System – Interim Operational Approval Guidance 08-01*, March 2008.

remote, aided visual, or automatic methods. The standards to train and qualify Armed Service UAS pilots and operators will remain under the Title 10 authority of DoD.

TECHNOLOGY

Ground-based Radars: Ground radars have the potential to detect aircraft and alert the pilot with suitable lead time to allow appropriate avoidance maneuvering, enabling safe mission operations and minimizing risk of airborne collisions. The DoD and FAA are currently conducting assessments of this technology.

Equipment Qualification / Certification: Currently, UAS with qualified equipment are able to fly within designated airspace. Since UAS equipment has not been designed in accordance with any specific UAS standards, the FAA requires a safety analysis to establish that a UAS sufficiently mitigates the probability of hazards to other NAS users and people and property on the ground.

5.2 Identify and Assess Future Capability Requirements

REGULATIONS, POLICY and PROCEDURES

Update Interim Policy and Guidance Material: Until the necessary standards, regulations, and compliance methodologies are defined for UAS, it will be difficult to establish regulatory compliance for more routine operations. Interim FAA UAS policy and guidance material is an opportunity to communicate to other organizations the most current policy decisions and acceptable practices related to UAS operational approvals.

Memoranda of Agreement: The existing DoD-FAA UAS Memorandum of Agreement, for example, is monitored to establish its effectiveness in expanding DoD UAS operations with fewer restrictions while still maintaining acceptable levels of safety. A successful safety record, supported by the collection and analysis of operational data, may lead to new or more efficient approaches. Elements of the DoD-FAA Memorandum of Agreement can be explored for reuse or adaptation for use by other federal agencies to promote cooperation, operational data collection, and expanded access.

Safety Case Methodology: A safety case is a critical element required to enable new or expanded operations in the NAS. It is a documented body of evidence that provides a convincing and valid argument that a UAS is safe to fly in the airspace required to complete its mission. The safety assessment is not limited to *see and avoid*, but any operational or technical implementation where the risk to the NAS has not yet been quantified and/or fully understood in order for the FAA to fully assess the risk. While development of a safety case is the responsibility of the UAS proponent, a common approach supported by guidance material may simplify data collection and provide a more consistent analytical approach.

Lost-Link Procedures: Currently, UAS implementations of lost-link procedures have not yet been standardized and uniformly validated with systems and performance data. These procedures need to be assessed for each UAS so that all stakeholders, including ATC, know what defines a lost-link event and agree to a set of procedures when a lost-link event occurs. DoD and FAA are collaborating on preliminary activities to establish criteria for UAS lost-link

procedures. The result will be considerations and recommendations for a standardized set of operational lost-link procedures to the UAS community.

Target Level of Safety: The fundamental safety requirements for manned and unmanned aircraft, alike, are to provide an acceptable level of risk to people and property in the air and on the ground. Between December 2008 and March 2009, subject matter experts from government, industry, and academia concluded that a Target Level of Safety (TLS) approach is most likely to succeed because it calls for a traceable, comprehensive end-to-end analysis that quantifies the total risk of the system.[12] A TLS is viewed by the FAA as a safety goal so standards, technology and procedures can be designed to allow expanded access, rather than a threshold by which UAS must comply.

STANDARDS

MASPS: UAS Minimum Aviation System Performance Standards (MASPS) will help in development of required design and operational standards to ensure safe, efficient, and compatible UAS operations with other aircraft operating in the NAS. These standards will provide a safety level comparable to that of manned aircraft. Adoption of these standards by FAA enables material solutions to be developed and procured according to a Technical Standard Order (TSO) for integration onto the aircraft.

Equipage: UAS must have the proper equipment to fly in the NAS. DoD needs to modify their existing standards or develop new DoD equipment standards for technology development, as well as a means for compliance. DoD will evaluate and prioritize standards gaps, and refer them to standards organizations for creation/revision and publication. Stakeholders will need to work closely with the standard development organizations and demonstrate compliance with standards and regulatory guidance from the FAA.

Airworthiness Certification: Airworthiness is a basic requirement for any aircraft system, manned or unmanned, to enter the airspace. Airworthiness certification ensures that aircraft systems are designed, manufactured, and maintained to enable safe flight. Certification criteria, standards, and methods of compliance establish a minimum set of design and performance requirements for safely flying a given category and class of aircraft. Certification takes into account system configuration, usage, environment, and the hardware and software of the entire system (e.g. aircraft, control stations, control and communications data links). It also considers design characteristics, production processes, reliability, and in-service maintenance procedures that adequately mitigate risk of injury/damage to people, property and and/or the environment.

Each military Department has a robust, structured, and repeatable airworthiness certification process for manned aircraft. The primary guidance for DoD airworthiness certification is found in MIL-HDBK-516B, *Airworthiness Certification Criteria*. MIL-HDBK-516B is the foundational document that establishes the criteria and basis for determining the airworthiness of all manned, unmanned, fixed wing, and rotary wing aircraft systems/vehicles. MIL-HDBK-516B defines airworthiness as “the ability of an aircraft system/vehicle to safely attain, sustain and terminate flight in accordance with an approved usage and limitation”.[13]

[12] Wolfe, Russell. *Why Demonstrating An “Equivalent Level Of Safety” For See And Avoid Is An Inappropriate Requirement For Unmanned Aircraft System Operations,* 28 May 2009.
[13] MIL-HDBK-516B with change 1, *Airworthiness Certification Criteria*. dated 29 Feb 2008

Industry and Military Standards: As programs are initiated, properly developed industry standards generally become military specification for a program of record (POR). All federal agencies and departments will use technical standards that are developed or adopted by voluntary consensus standards bodies to the maximum extent possible rather than developing government-unique specifications. Civil standards organizations such as ASTM, SAE, and RTCA are developing many standards specific to UAS.

Military standards, specifications, and technical orders serve as the basis for military acquisition, certification, and operations. However, many UAS have been operationally fielded due to nature of the demand without the established procurement process. In these cases, standards are initiated by the organization with the demand, or the program of record can make changes later in development as resources allow.

TECHNOLOGY

NextGen: UAS integration activities need to include NextGen technology not only to ensure compatibility and ease of access in the future NAS, but to capitalize on the performance and safety benefits of NextGen technology. To ensure long term integration into the NAS, UAS need to be included in all appropriate aspects of NextGen planning.

Frequency and Bandwidth: The FAA and DoD UAS Task Force Frequency and Bandwidth (F&B) Integrated Product Team (IPT) are cooperatively evaluating spectrum regulatory and aviation requirements to operate safely in the NAS. The IPT supports technical and regulatory analysis for potential UAS control and communication (C^2), ATC voice communications, and Sense and Avoid (SAA) global operational frequency bands for future non-segregated airspace. While flexibility to use current and/or preferred equipment for C^2 and SAA functions is part of the overall spectrum access strategy, harmonization between frequency needs and minimum performance requirements and standards is key.

Sense-and-Avoid: Analysis of SAA approaches and technologies is critical to meeting NAS access needs. Continuation of existing and planned efforts, such as the FAA SAA workshops, to define a set of agreed upon performance parameters and assessment methodologies for SAA is key to understanding and moving towards a viable and safe SAA implementation strategy for UAS. Ground-based radar initiatives will help gather, test, and verify data, along with the appropriate modeling and simulation activities, to establish requirements and construct a safety case. Other approaches to consider include an onboard (airborne) sense and avoid solution (ABSAA). ABSAA efforts are currently focused on developing the capability to perform both self separation and collision avoidance onboard the aircraft that ensure an appropriate level of safety.

Automation: Advanced algorithms are a means of merging technology innovation and practical application. An assessment of existing “safety of flight” algorithms in the context of UAS performance parameters may identify similarities and differences between manned and unmanned to validate the suitability of existing algorithms or the need to develop new ones.

6 IMPLEMENTATION

To allow UAS routine and unfettered access to NAS, regulations, policy and procedures, standards, and technology must be fully developed and complementary. Furthermore, compliance with those policies and standards must be validated. The implementation plan listed below is categorized both chronologically and functionally. Near-term solutions generally involve policy and procedures, as well as development of technology. Mid-term solutions generally align with the further development and validation of standards and technology, and far-term solutions generally refer to the development of technology and appropriate regulatory standards and compliance methods to meet UAS-specific NAS access needs.

The timeframes for this Plan are consistent with those found in the President's National Aeronautics Research and Development Plan[14], which specifies less than 5 years in the near-term, 5-10 years in the mid-term, and greater than 10 years for the far-term. While the development of standards and technology may take some time to complete, near-term efforts can help increase UAS access to the NAS immediately and will not require 5 years to complete. Mid- and far-term efforts will continue to develop as fast as possible while maintaining the safety of the NAS.

6.1 Near-Term (2010-2015)

Ongoing efforts to increase NAS access involve continuing development of new, or changes to existing regulations, policy, and procedures, as well as technology development. Some examples of existing efforts include the ExCom COA working group, the small UAS SFAR, current technology development, and the development of technical standards. The near-term products are described below and listed in Table 6. Scheduling of these products is to be determined through the interagency decision making process.

SAFETY CASE METHODOLOGY

While the issue of safety case methodology is being considered by the ExCom COA working group, this issue will require considerable interagency action to resolve and is a critical near-term activity that will lay the foundation for operational approvals. The ExCom member organizations are establishing guidelines for safety case requirements. These guidelines should create clearly defined and standardized content that can be used by proponents when submitting a COA application. The guidelines will be based in part on safety data collected from UAS operations and shared among ExCom member organizations.

COA PROCESS WORKING GROUP

The ExCom established a COA working group to identify issues and recommend solutions to improve airspace access via COAs. Some issues the working group is trying to resolve include: the current backlog of applications, the long timeframe for approval, prioritization and quality control of the applications, clarity of application language, and process transparency.

It is expected that the COA working group will identify larger NAS access issues outside of the group's capacity to address. These issues will serve as input to the NAS access process outlined in this Plan.

[14] The National Science and Technology Council, *National Aeronautical Research and Development Plan*, February 2010

PRODUCTS AND PROCESSES FROM AGENCY AND INTERAGENCY EFFORTS

There are several current and planned activities both within and between Excom member organizations intended to address specific aspects of UAS integration challenges.

Outputs from these activities may also serve as inputs into the NAS access process outlined in this Plan.

INTERAGENCY AGREEMENTS

In some cases, products and processes resulting from this Plan may be implemented via the establishment of new, and update of existing, Interagency Agreements.

DEVELOP SITE TRANSITION PLAN

It is incumbent upon individual ExCom member organizations to develop their own site-specific airspace integration plans for UAS operations in the NAS, as needed. These plans should also address concept development and validation.

TECHNICAL DEVELOPMENTS

Organizations should gain experience with near-term technical developments such as use of ground-based sensors to sense targets in the airspace where the UAS is operating. Emerging technical developments should include plans for validation in their respective operating environments.

Table 6: Near-Term Implementation Products

Near-Term Implementation Products	
COA Working Group	• COA Process Improvements • COA Policy Improvements • COA Operational Improvements
Safety Case Methodology	• Define Safety Case Data and Products • Establish Guidelines and Approach • Define Methods of Application
Interagency Agreements	• Further Define Roles and Responsibilities • Promote Cooperative Efforts • Document COA Process Agreements • Define Safety Case Methodology • Clarify Existing Procedures • Implement Lost-Link Procedures • Implement Small UAS SFAR Safety Basis • Set Provisions for Certain UAS in Certain Types of Airspace
Transition Plan	• Assess Feasibility of Proposed Approaches • Select and Implement Effective Solutions • Continue to assess effectiveness against changing requirements

6.2 Mid-Term (2015-2020)

Where policy, procedures and near-term technologies fall short of achieving the longer-term objectives for more routine access, a significant investment in standards and technology development is necessary. Mid-term activities include developing validated airspace integration requirements and associated standards. A Sense-and Avoid-capability must be established that will provide NAS access through special rules or policy, new procedures, or technologies. The mid-term activity products are described below and listed in Table 7. Schedules will be developed through the interagency decision making process.

CERTIFY GROUND-BASED SENSE-AND-AVOID SYSTEM

The DoD, in coordination with FAA, will develop a certification approach for a system or set of systems, e.g. ground-based radar, to contribute to safe aircraft separation and collision avoidance. The technology will be developed in conjunction with other risk mitigation efforts to gain incremental access to the NAS without a chase aircraft or ground observer. This technology is being called Ground-based Sense and Avoid (GBSAA) and consists of any combination of policy, procedures, and technology derived from a ground-based sensor intended to facilitate safe NAS access over land or water.

Table 7: Mid-Term Implementation Products

Mid-Term Implementation Products	
Certified GBSAA	• Establish requirements • Test & Verify Data • Determine Policy • Develop Procedures • Optimize Ground based sensor technology (e.g. radar) • Develop Fielding Plans
Standardize Procedures	• SAA Procedures • Information coordination • Automation • Contingency Planning
Initial ABSAA	• Collect & Analyze Data • Test & Verify Data

STANDARDIZE PROCEDURES

Many of the procedural agreements provided in the near term will need to consider standards to ensure that desired UAS operations can be conducted on a more routine basis. This includes clear documentation for aircraft separation, collision avoidance, coordination of information, automation, and contingency planning. An agreed upon target level of safety will help drive the analysis in developing these parameters and allow even more clarity and robustness to safety planning.

INITIAL AIRBORNE SENSE-AND-AVOID CAPABILITY

The Air Force and Navy are both developing ABSAA systems for their respective programs. This capability needs to be standards-based and will be limited in the mid-term and thus may need to be used in coordination with other safety critical technologies such as TCAS. The initial capability will provide an ability to collect and analyze valuable data for developing a robust airborne SAA system.

6.3 Far-Term (2020-2025)

The end state is routine NAS access comparable to manned aircraft for all UAS. Far-term activities include developing, certifying, and fielding UAS enabling technologies to approved technical standards and performance specifications. The far-term addresses all UAS missions in any NAS location. These activity products are described below in Table 8.

TECHNICAL STANDARDS

The FAA will approve appropriate technical standards and performance specifications for enabling technologies. Once there is a complete set of UAS standards, new technology solutions can be developed with much reduced risk.

CERTIFY A SENSE-AND-AVOID SYSTEM

Fully developed and certified technology and procedures (i.e. an ABSAA system with an appropriate level of automation) will provide the means to fly dynamically in the NAS. This will include collaborative sensor technology and algorithms for self-separation and collision avoidance. Requirements will also need to include the equipage necessary to integrate into FAA's NextGen.

Table 8: Far-Term Implementation Products

Far-Term Implementation Products	
Technical Standards	• Approve Technical Standards • Approve Performance Specifications
Certified ABSAA	• Establish Requirements • Develop Policy & Procedures • Certify SAA Capability, including ABSAA Sensor Technology

6.4 Notional Timeline

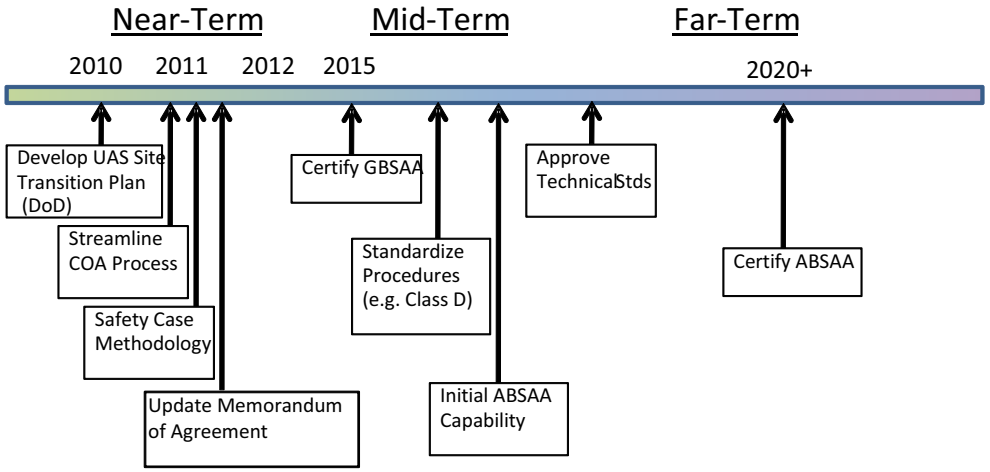


Figure 9: 2010 Notional Timeline

7 RECOMMENDATIONS

Specific recommendations will be generated through the systematic application of the methodology outlined in Section 2 of this Plan. While this methodology ensures that all ExCom members will benefit from the products of joint activities, the DoD has developed a set of recommendations outlining several concepts of operations focused on meeting their specific needs. These would need to be addressed in a collaborative and incremental manner in accordance with the approach and methodology process identified in this Plan.

Some operations such as visual line of sight and terminal area operations are currently being approved with COAs and under the provisions of the 2007 DoD-FAA MOA. Expansion of the use of these mitigations for see-and-avoid and compliance with ATC clearances would be included in the process outlined in section 2 of this Plan.

Lateral Transit Operations, Vertical Transit Operations and operations within a MOA are also currently being approved with COAs. See and avoid safety mitigations are required and listed in the COA to protect the public's right to access. Prohibition of the public's right to access will not be considered in this Plan.

DEPARTMENT OF DEFENSE RECOMMENDATIONS

Over the past several years, the DoD has conducted an assessment of specific airspace access needs for its UAS and has consolidated these needs into six broad-based access groups, shown in and described below. These groups provide a general categorization for specific airspace needs into potential solution sets. Largely organized around phases of flight, each group addresses a subset of the organizational needs identified in Section 3 of this Plan, including a number of DoD, DHS, and NASA common access requirements. Properly ordered, each access group could allow for incremental implementation of potentially repeatable access approaches through developed and validated policies, procedures and technologies. The DoD has already adopted these access groups as the core of the *DoD Airspace Integration Plan*.

GROUP 1: LINE-OF-SIGHT OPERATIONS

The Line-of-Sight (LOS) access group (Figure 10) addresses a wide range of DoD, DHS, and NASA requirements to operate UAS within a limited geographical area under Visual Meteorological Conditions (VMC). Largely leveraging time-tested and widely-understood visual separation and sequencing procedures, visual LOS operations call for a visual observer to be in sight of the UAS, surrounding air traffic, ground/weather hazards, and in direct communication with the pilot in command during the flight. The observer may be located on the ground, in a vehicle/boat, or in an aircraft. Air traffic control communications may or may not be required based on operations and location.

Visual LOS operations are currently implemented at dozens of locations across the country. The capability to conduct visual LOS operations satisfies a large percentage of DoD training needs and also are primary to tactical surveillance and aeronautics research relating to small UAS.

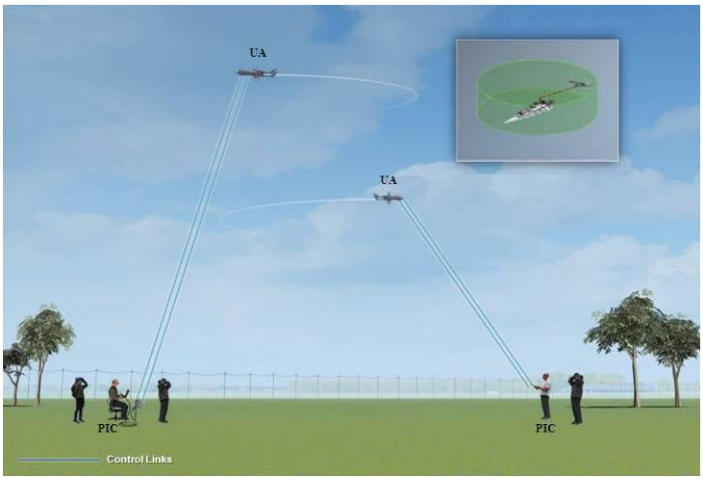


Figure 10. Line of Sight Operations

GROUP 2: TERMINAL AREA OPERATIONS

The Terminal Area Operations access group (Figure 11) is intended to address the core functions of UAS launch, recovery, and transition to other phases of flight. This group is designed to capture a range of common airfield operations, including functions such as clearance, engine start, taxi, takeoff, climb, departure, local pattern, arrival, approach, and landing. This group is intended to address shared manned/unmanned flight activities in this environment, day or night, and includes the potential to operate multiple UAS concurrently.

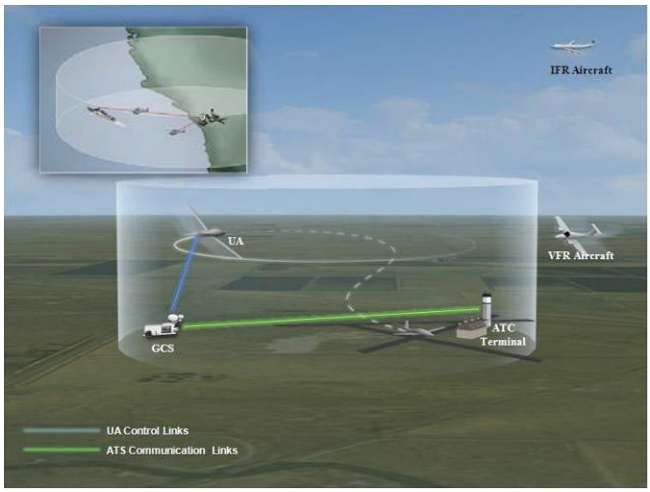


Figure 11: Terminal Area Operations

GROUP 3: MILITARY OPERATIONS AREAS

The Military Operations Area (MOA) access group (Figure 12) is intended to provide DoD UAS the ability to leverage nearly 500 existing MOAs (spanning 43 states and providing over a half million square miles of operating space) to provide a robust, nationwide UAS training capability to Active and National Guard units without the creation of new airspace categories. Utilizing existing MOAs would allow DoD UAS ready access from a wide variety of locations, and enable military units to "train as they fight" alongside other DoD assets in military-designated airspace specifically designed for military training.

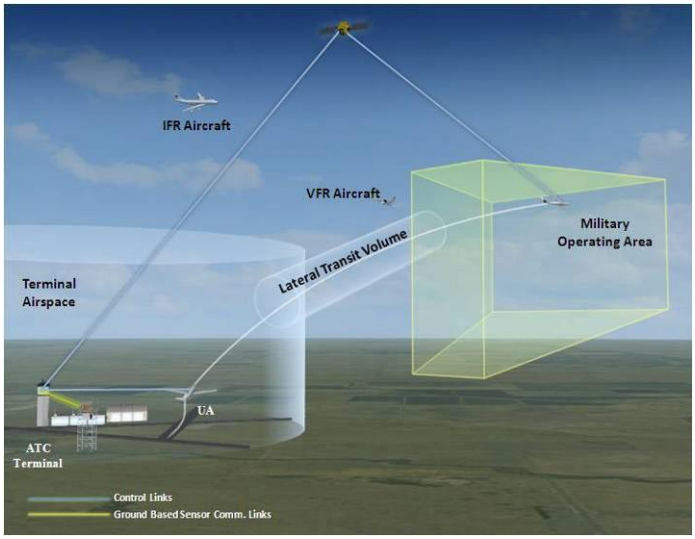


Figure 12: UAS MOA Operations

GROUP 4: LATERAL TRANSIT OPERATIONS

The Lateral Transit access group (Figure 13) builds upon the capability established in the Terminal Area and Military Operations categories by providing a construct for UAS to transition across the airspace between the airfield and a designated UAS operating area (such as a Military Operations Area or Restricted Area). Safe passage through the connecting transit volume of airspace would be ensured by the utilization of acceptable technologies designed to ensure that all aircraft are identified and a safe distance would be maintained between the UAS and other aircraft. Recommendations associated with the Lateral Transit access group are largely common with those presented for the Military Operations Area group.

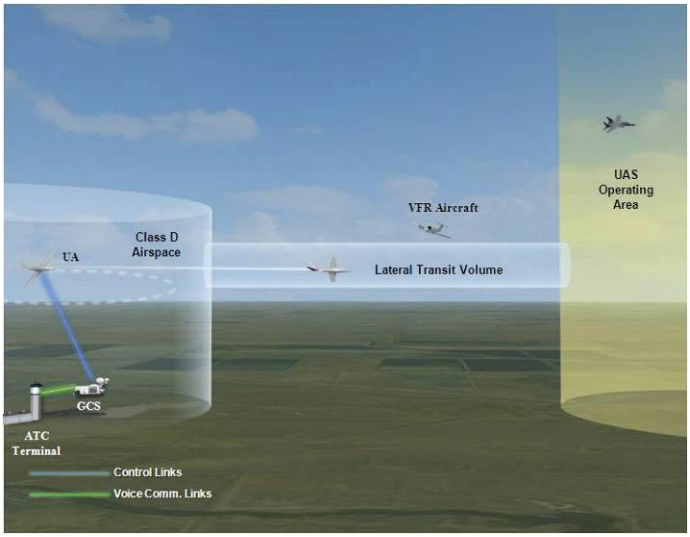


Figure 13: Lateral Transit Operations

GROUP 5: VERTICAL TRANSIT (CYLINDER) OPERATIONS

The Vertical Transit access group (Figure 14) also builds upon the capability established in the Terminal Area by providing a cylindrical construct for UAS to transition vertically between the airspace at the ceiling of the Terminal Area and the floor of the Class A airspace above. This group is designed to support a wide variety of DoD, DHS, and NASA missions that require access to higher altitude strata, and/or the ability to leverage the advantages of operating within the positively-controlled ATC flight environment that Class A airspace provides.

Recommendations associated with the Vertical Transit access group are largely common with those presented for the Lateral Transit and MOA access categories.

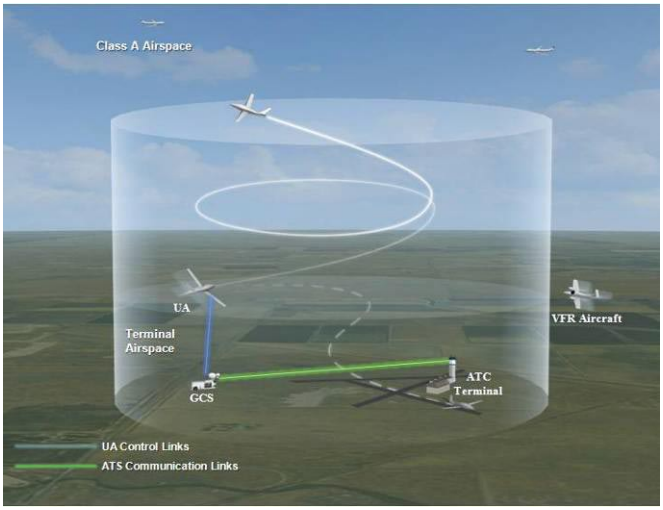


Figure 14: Vertical Transit (Cylinder) Operations

GROUP 6: DYNAMIC OPERATIONS

The Dynamic Operations access group (Figure 15) is intended to address those mission needs that require robust access to the NAS comparable to today's manned aircraft. The mission needs require flexibility in meeting rapidly changing contingency requirements, real-time scheduling/execution of UAS flights, and near-complete integration of suitably-capable UAS with manned aviation platforms. Dynamic operations will likely require a system-wide approach to addressing many of the current UAS access issues, and are thus envisioned as a longer-term implementation--perhaps associated with the Next Generation Transportation System initiative. This group should enable the proponent of an appropriately equipped UAS to file a real-time flight plan and then perform the end-to-end activities listed in that flight plan.

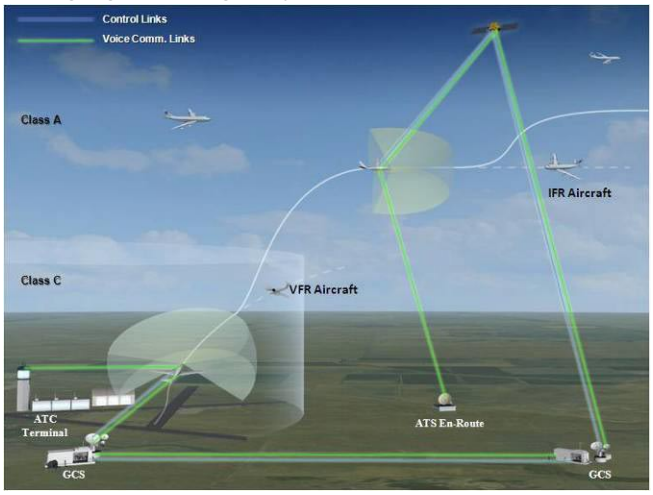


Figure 15: Dynamic Operations

8 NAS ACCESS PLAN SUMMARY

As part of the NAS Access Plan for Federal Public UAS, the recommendations in this section are intended to be used in the process to introduce UAS safely and more broadly into the NAS to meet the operational and regulatory needs of ExCom member agencies.

This is the first step in organizing multi-agency government efforts relating to UAS operations in the NAS and addressing the increasing needs for access on a permanent basis.

Table 9. Airspace Access Recommendations

- Policy & Regulations
  - Allow DoD/NASA/DHS to use the safety basis that is being considered in the small UAS policy efforts within the FAA
  - Expand operations for small UAS operations beyond military reservations and over unpopulated areas (day/night)
  - Fully document a common safety case approach and methodology
  - Subject to meeting safety requirements, allow certain appropriately certified systems to serve as a method to sense and avoid.
  - Develop an acceptable Target Level of Safety to support the development of standards, technologies and procedures
  - Update interagency agreements such as the 2007 DoD-FAA Memorandum of Agreement
  - Include UAS in all appropriate aspects of NextGen planning efforts
- Procedures
  - Expand operations at non-joint use airfields and support transition to adjacent restricted or warning areas (day/night)
  - Develop and document agreed upon operational procedures (e.g. lost link, divert, recovery)
- Technology
  - Develop and certify enabling technologies (e.g. displays, alert systems, ground-based radars, and airborne sensors)
  - Expand DoD/NASA/DHS/FAA UAS flight testing, validation and certification of technologies

ATTACHMENT 2

DoD Site Transition Plan

October 2010

Office of the Undersecretary of Defense for Acquisition, Technology & Logistics

DoD Attachment to Final Report to Congress on the Access to National Airspace for Unmanned Aircraft Systems

Table of Contents

Table of Figures

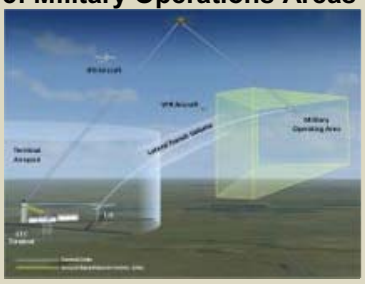
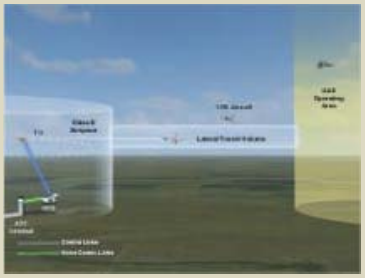
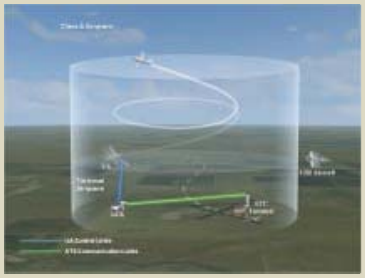
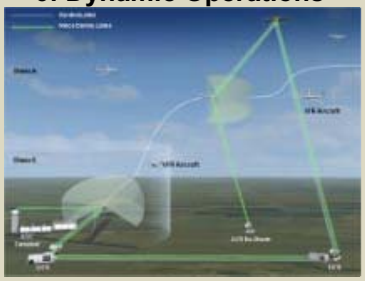
Table of Tables

INTRODUCTION

Over the past several years, the DoD has conducted an assessment of specific national airspace system (NAS) access needs for its UAS and has consolidated these needs into six broad-based access groups. These groups provide a general categorization for specific DoD airspace needs into easily-understandable potential solution sets. The groups are shown in Table 1 and are described in more detail later in the document.

Largely organized around phases of flight, each group addresses a subset of the organizational needs identified in the *NAS Access Plan for Federal Public UAS*. Properly ordered, each access group will allow for incremental implementation of potentially repeatable access approaches through developed and validated policies, procedures and technologies. The DoD has already adopted these access groups as the core of the *DoD Airspace Integration Plan*.

Table 1. DoD Airspace Access Profiles

DoD Airspace Access Profiles		
1: Line of Sight 	**2: Terminal Operations** 	**3: Military Operations Areas** 
4: Lateral Transit 	**5: Vertical Transit** 	**6: Dynamic Operations** 

These groups are all shown together in an operational view (Figure 1) and could be used as an individual access group or integrated together to satisfy all possible airspace requirements. The Special Use Airspace (e.g. Military Operations Area, or "MOA") can be accessed either through a lateral corridor (through Class E) or by way of vertically ascending to Class A airspace and flying across.

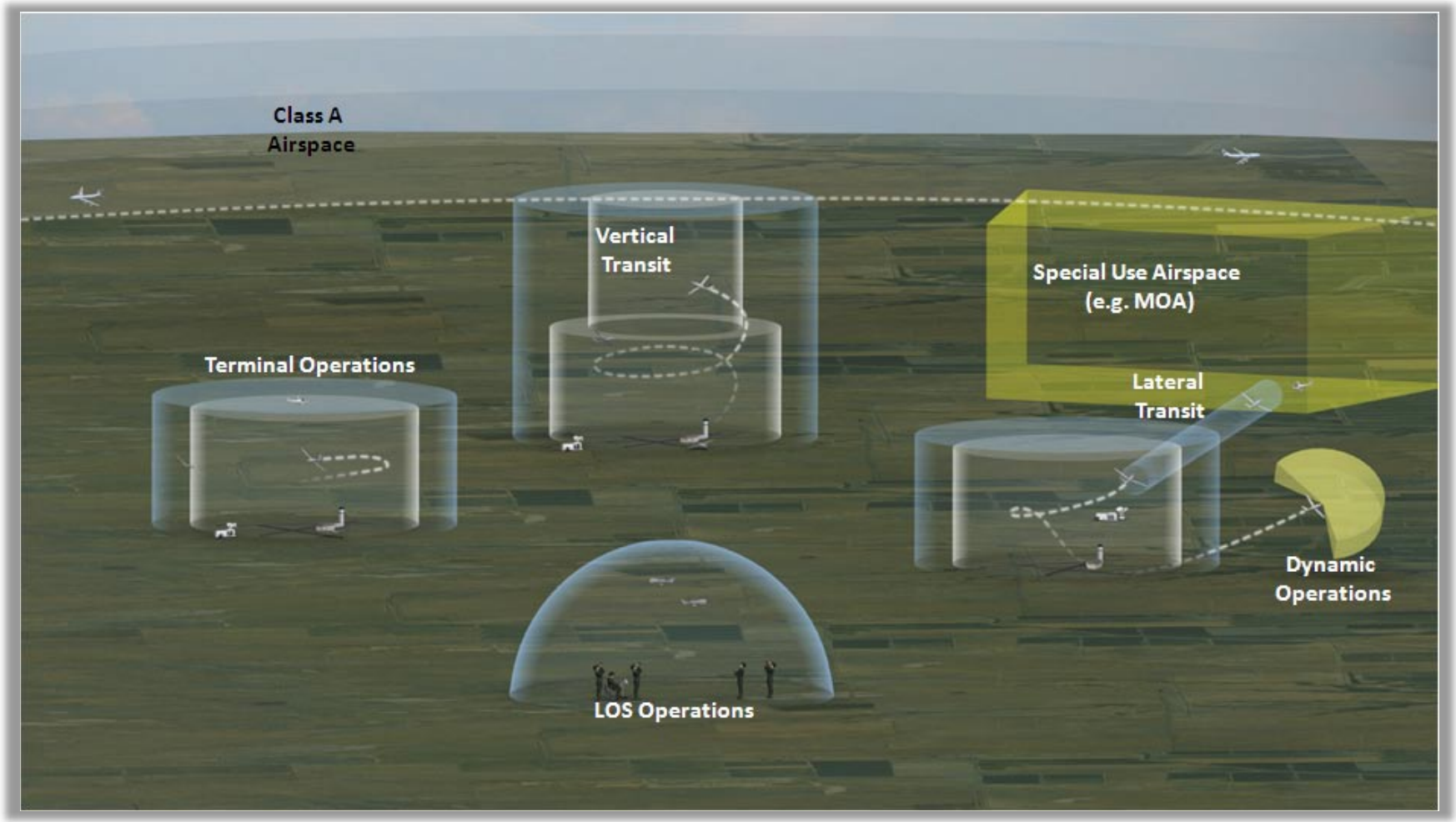


Figure 1. Operational View for Airspace Integration

The military Service airspace access requirements have been captured by the Joint UAS Center of Excellence and grouped into the six access groups. Each individual UAS airspace requirement is associated with a formal request from the Service to the FAA in the form of a Certificate of Waiver or Authorization (COA). The current set of approved COAs provides a baseline for military NAS access requirements, although the Services have requirements that extend beyond the formal requests.

Table 2: Current DoD COAs and Future Needs Divided Into Access Groups

		Line of Sight Operations	Terminal Operations	Military Operations Areas	Lateral Transit Operations	Vertical Transit Operations	Dynamic Operations	Totals
Air Force	2010	1		(8)*	5	5		10
	2015	1	3		8	7		20
Army	2010	2	18	(13)*	5			23
	2015	28	35		10			64
Marine Corps	2010	1	2	(5)*	1			3
	2015	11	2		3			3
Navy	2010	3		(5)*	4	1		7
	2015	6	4		8	3		18
SOCOM	2010	8	5	(7)*	1			14
	2015	13	12		8	1		34
Total	2010	15	19	(32)*	16	6	1	57
	2015	59	43		33	10	1	138

* Forecasting the military's requirements in FY15 cannot be done exclusively by looking at their COA projections. In particular, the Services may have very different requirements if they had less operational restrictions for flying with or without a COA in MOAs. Therefore, the MOAs listed in the table are only listed as notional possibilities, further descibed below.

LINE-OF-SIGHT OPERATIONS

DoD requires immediate access to local airspace (primarily in uncontrolled Class G) for small UAS to conduct UAS operations within Visual Flight Rules (VFR) conditions. Visual Line of Sight (LOS) operations are needed to satisfy a large percentage of DoD training needs and also are primary to tactical surveillance and aeronautics research relating to small UAS. This category primarily enables volume operations with smaller UAS, with some useful application for larger aircraft. These operations call for a visual observer to be in sight of the UAS, surrounding air traffic, ground/weather hazards, and in direct communication with the pilot/operator during the flight. The observer can be located on the ground, in a moving vehicle/boat, or in a chase plane. Air traffic control communications may or may not be required based on operations and location (Figure 2).

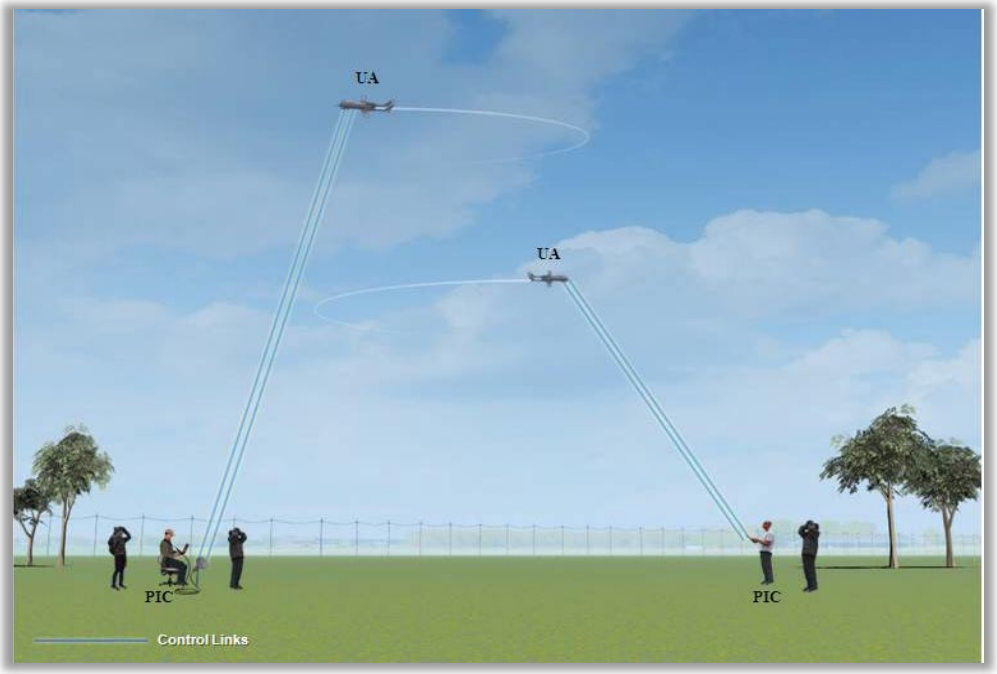


Figure 2. Line-of-Sight Operations

Many line-of-sight operations are currently conducted in Class G airspace in accordance with the restrictions outlined in the 2007 DoD-FAA Memorandum of Agreement. Under the agreement, the Services only need to notify the FAA regional traffic control services of small UAS activities and do not require a COA in most cases.

One exception is that small UAS LOS operations within 30 NM of Class B airspace with a Mode C veil do require a COA. Most small UAS operations occur without an airfield, however a few require takeoff and landing with an airfield. See Table 3 for details.

The small UAS Aviation Rulemaking Committee (ARC) was convened to review current regulatory policy and provided specific recommendations to the FAA. The FAA is considering the ARC recommendations as it develops a special federal aviation regulation (SFAR). If the SFAR passes the recommendations largely unchanged, it will dramatically improve the ability to fly LOS operations in the future. If the SFAR is not in effect, there will be many more new LOS COAs required.

Table 3: FY10 LOS Operation COAs

	Service	Location	UA System	Notes
1	Air Force	Santa Fe, NM (Playas)	ANG RQ-11B Raven	
2	Army	Simi Valley, CA	RQ-11B Raven	
3	Army	Cubero, NM	gMAV	
4	Marine Corps (USMC)	Kaneohe, HI	RQ-11B Raven	
5	Navy	Laguna Pueblo, NM	T-Hawk (MAV)	Night training disapproved
6	Navy	Carrizo Springs, TX	Buster	Night flying disapproved
7	Navy	Inarajan, Guam	ScanEagle	Class G and E airspace below 2000 AGL
8-9	Special Ops Cmd (SOCOM)	Taft / Brenen Field, CA	Puma, Wasp	Puma approved up to 600 and 400 AGL only (requested 1,100 and 600 AGL). Wasp approved up to 400 AGL (requested 700 AGL).
10-11	SOCOM	Stennis Space Center, MS	RQ-11B Raven, Wasp	Both Wasp and Raven approved up to 400 AGL (Wasp requested 500 AGL, Raven requested 1000 AGL); night ops denied.
12-13	SOCOM	Fort Story, VA	RQ-11B Raven, Wasp	Includes Class E & G airspace 700/1000 AGL and below; ops Area starts at 5.5 NM from approach end of Norfolk airport
14	SOCOM	USAFA Airstrip, CO	AFSOC Viking	
15	SOCOM	Fentress NALF, VA	RQ-11B Raven	Approved for at or below 750 AGL (requested 1,000 AGL). Ops in Class E within 2.5 NM of a runway

TERMINAL AREA OPERATIONS

DoD has a need to operate in the terminal environment at operating locations (including the surrounding Class D, E, or other airspace) to conduct all phases of flight and requisite support activities. Terminal area operations involve operations in a terminal area that participate in or otherwise impact the pattern. They include, but are not limited to, clearance, engine start, taxi, takeoff, climb, departure, local pattern, arrival, approach, and landing. DoD needs to be able to conduct shared manned and unmanned flight activities in this environment, day or night, and also needs to operate multiple UAS concurrently.

DoD, in partnership with FAA, is already evaluating the application of potential technologies intended to enable terminal area operations safely and expeditiously without the use of ground observers. Validated radar technology, communications architecture, display screens, along with the appropriate procedures, provides the capability to ensure safe aircraft separation (see Figure 3).

Most of the terminal operations are currently for Class D airspace operations with adjoining restricted airspace, but some are for Class D surface area operations only (Table 4). Many more similar types of operations are expected in FY15 (Table 5).

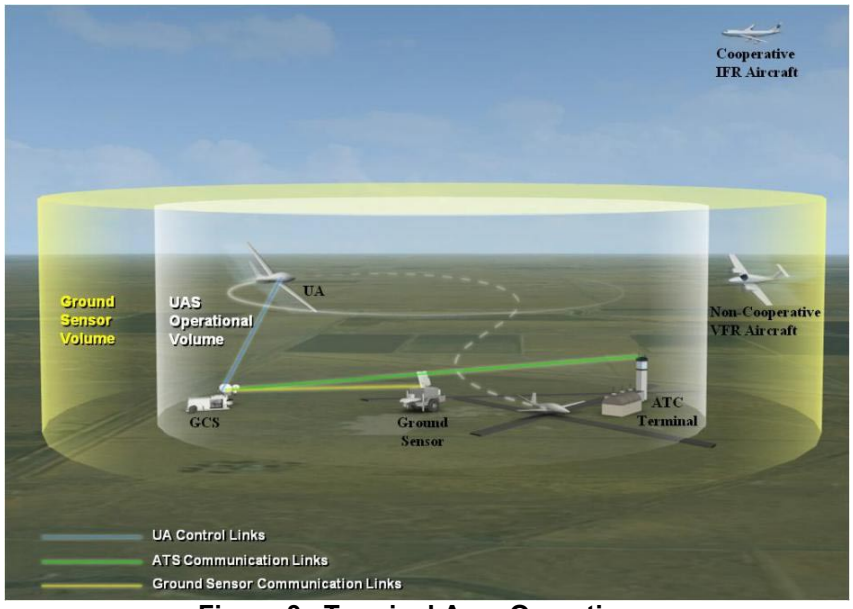


Figure 3. Terminal Area Operations

Table 4: FY10 Terminal Operation COAs

	Service	Location	UA System	Notes
2	Army	Redstone AAF, AL	RQ-7B Shadow	Class D adjoining RA. Night ops with conditions.
3	Army	Cochise College, AZ	MQ-5B Hunter	Class D surface area operations only. Joint Use Class G airfield. Hunter Contract Operator Training
4-5	Army	Ft. Huachuca, AZ	Warrior A, Warrior 0-1	Class D with adjoining restricted airspace
6	Army	Victorville, CA	A-160T	Class D
7-8	Army	Fort Stewart, GA	MQ-5B Hunter, RQ-7B Shadow	Joint-use Class D with adjoining restricted airspace. Night ops for launch/recovery only with conditions
9	Army	Ft. Knox, KY	RQ-7B Shadow	Class D
10	Army	Schofield Barracks, HI	RQ-7B Shadow	Class D adjoining restricted airspace. Night ops for launch/recovery permitted with conditions.
11	Army	Camp Ripley, MN	RQ-7B Shadow	Class D adjoining RA. Night ops with conditions.
12	Army	Camp Shelby, MS (Hagler AAF)	RQ-7B Shadow	Class D. Night ops disapproved.
13	Army	Fort Drum, NY	RQ-7B Shadow	Class D adjoining RA. Night ops with conditions.
14	Army	Fort Polk, LA	RQ-7B Shadow	Class D adjoining RA. Night ops with conditions.
15	Army	Indiantown Gap, PA	RQ-7B Shadow	Class D
16	Army	Ft. Bliss, TX	RQ-7B Shadow	Class G/E

	Service	Location	UA System	Notes
17	Army	Ft. Hood, TX	MQ-5B Hunter	Class D. Night ops with conditions
18	Army	Fort AP Hill, VA	RMAX	Class D
19	Army	Felker AAF, VA (Ft Eustis)	Vigilante VTOL	Class D surface area operations only. non-joint use
20	USMC	Bogue Field, NC	Shadow	Class D adjoining RA. Night ops with conditions
21	USMC	Kaneohe, HI	RQ-11B Raven	Ops within 30 NM of HNL airport; Class G ops at Bellows training area.
22-24	SOCOM	SSTC, CA	Wasp, Raven	Class D surface area operations only. Operations within 30 NM of San Diego Int'l Airport. Agreement in place for RQ11B operations in Class D; joint use airfield
25	SOCOM	Choctaw NOLF, FL	Wasp, Raven, Puma, ScanEagle	Under provisions of DoD-FAA MoA. Multiple simultaneous UAS allowed
26	SOCOM	Cannon AFB, NM	MQ-1 Predator	Under provisions of DoD-FAA MoA

Table 5: Expected Terminal Operations in FY15

	Service	Location	UA System	Notes
1	Air Force	Holloman AFB, NM	MQ-1 Predator MQ-9 Reaper	Class D -> restricted area
2	Air Force	Syracuse, NY (Wheeler Sack AAF)	ANG MQ-9 Reaper	Launch and recovery operations from Ft Drum Class D adjoined to restricted area
3	Air Force	Fort Polk, LA	ANG Predator	Class D to restricted area
4	Army	Whetstone, AZ	RQ-7B Shadow	Class G/E
5	Army	Camp Roberts, CA	RQ-7B Shadow	Class G
6	Army	El Mirage, CA	Warrior A	Class D
7	Army	Moffett Field CA	RMAX	Class G
8	Army	Ft. Ord, CA	RMAX	Class G
9	Army	Fort Stewart, GA	MQ-1C ERMP	Joint Use; Class D -> restricted area
10-11	Army	Fort Riley, KS	MQ-1C ERMP, RQ-7B Shadow	Class D to restricted area
12	Army	Fort Campbell, KY	MQ-1C ERMP	Class D to restricted area
13	Army	Fort Knox, KY	RQ-7B Shadow	Class D to restricted area
14	Army	Camp Edwards, MA	RQ-7B Shadow	Class D to restricted area (ops out of OTIS AFB)
15	Army	Camp Grayling, MI	RQ-7B Shadow	Joint Use Class D to restricted area
16	Army	Fort Bragg, NC	MQ-1C ERMP	Class C -> RA (operate out of Pope AFB)
17	Army	Fort Sill, OK	RQ-7B Shadow	Class D to restricted area
18	Army	Hondo, TX	Buster	Class G
19	Army	Fort Hood, TX	MQ-1C ERMP	Class D -> E -> restricted area
20	Army	Fort AP Hill, VA	RQ-7B Shadow	Class G
21	Navy	San Diego, CA	STUAS	Ops on North Island Class D; within 30 NM of SAN
22	Navy	Norfolk, VA	PUMA	NAS Class D surface area
23	Navy	Portsmouth, VA	STUAS	Norfolk NAS Class D surface area
24	Navy	Everett, WA	STUAS	Everett Class D, within 30 NM of Seattle airport
25	SOCOM	San Clemente Is, CA	RQ-11B Raven	Class D -> restricted area
26	SOCOM	Vandenberg AFB, CA	Viking 400	Class D -> restricted area
27	SOCOM	Fort Campbell, KY	MQ-1C ERMP	Class D -> restricted area
28	SOCOM	Pope AFB, NC	Viking 400	Class C -> restricted area
29	SOCOM	Shaw AFB, SC	Viking 400	Class D -> restricted area
30	SOCOM	McChord AFB, WA	Viking 400	Class D -> RA. Within 30 NM of Seattle airport
31	SOCOM	NAB Coronado, CA	PUMA AE	Ops on North Island Class D; within 30 NM of SAN

MILITARY OPERATIONS AREAS

DoD needs to operate UAS freely and at their discretion within a given volume of airspace (other than existing Restricted and Warning Areas) that are associated with internally managed UAS bases and locations to conduct a variety of flight activities.

Military Operations Areas (Figure 4) provide exceptionally well-suited functionality for DoD UAS operations. By definition, MOAs are "airspace established outside Class A airspace to separate or segregate certain non-hazardous military activities from IFR Traffic and to identify for VFR traffic where these activities are conducted." UAS operations are inherently non-hazardous, however they require a certain level of segregation in order to appropriately exercise their full capabilities. MOAs clearly identify to other NAS users that military specific operations may be conducted, and that associated risks are associated with transit through them. MOAs support on-the-fly changes to direction and altitude within the operating area, and allow for real-time changes to flight durations, entries and recoveries as mission and training needs dictate. Safe operations within MOAs can be enabled through the appropriate development of procedures and can rely on validated radar technology, such as optimized surveillence radar.

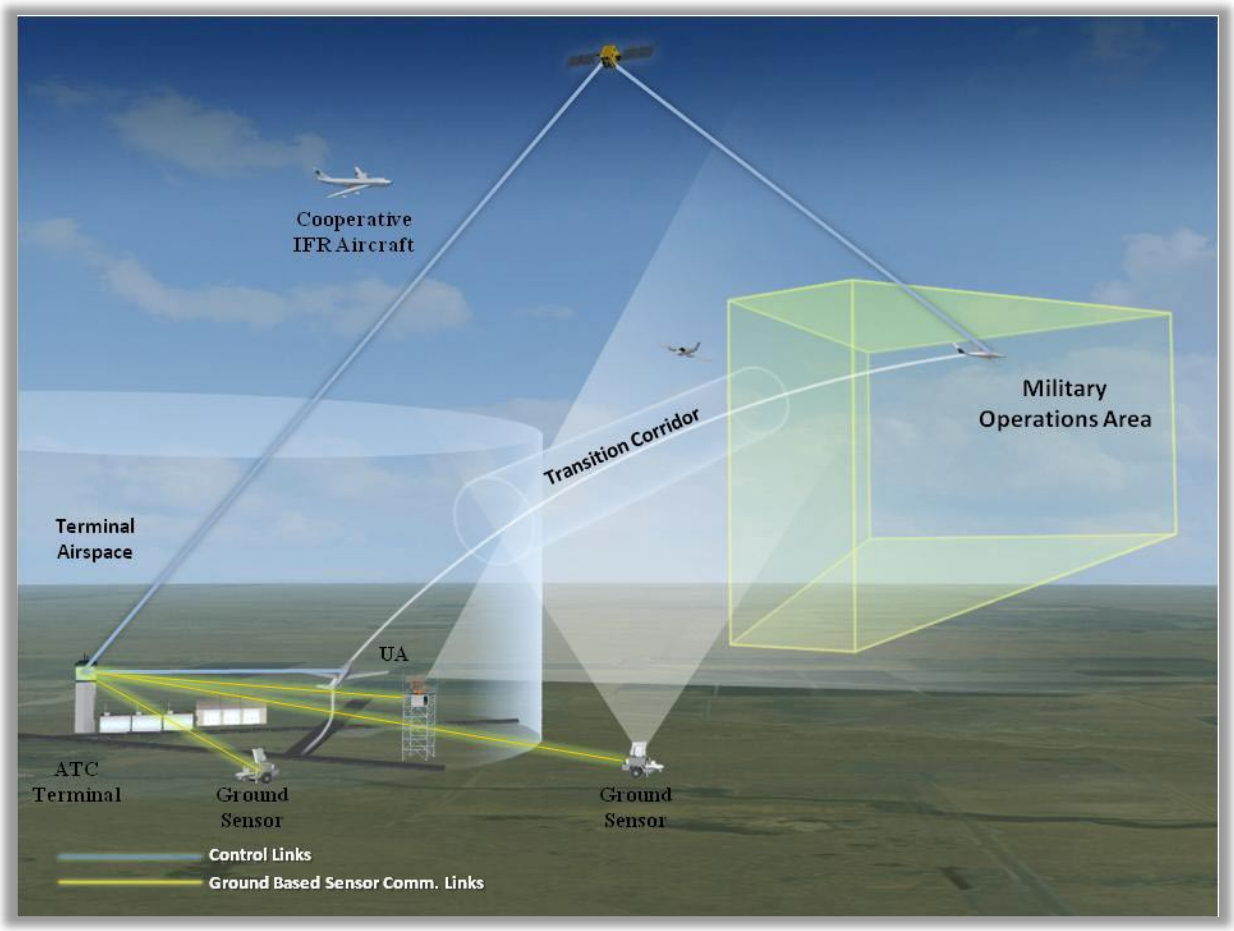


Figure 4. MOA Operations

Nearly 500 existing MOAs have the capability to provide DoD UAS the ability to leverage access to spanning 43 states and over a half million square miles of operating space (Figure 5). MOAs provide a robust, nationwide UAS training capability to Active and National Guard units without

the creation of new airspace categories. Utilizing existing MOAs would allow DoD UAS ready access from a wide variety of locations, and enable military units to "train as they fight" alongside other DoD assets in military-designated airspace specifically designed for military training.

Figure 5. Potential Locations to Utilize MOAs

A preliminary review of UAS basing locations and their proximity to MOA airspace reveals a number of potential options for each UAS operation to consider (Table 6). These locations are graphically overlaid onto a map of the contiguous United States in Figure 5.

Table 6. Potential Operations in MOAs

	Service	Location	Potential UA System	Notes
1	Air Force	El Mirage, CA	MQ-1 Predator, MQ-9 Reaper	Class D/E adjoining restricted airspace and MOA
2	Air Force	Beale AFB, CA	RQ-4 Global Hawk	Nearby MOAs
3	Air Force	Fort Polk, LA	ANG Predator	Class D with adjoining restricted airspace and MOA
4	Air Force	Fargo, ND	ANG MQ-1 Predator	Class D -> E -> A with nearby MOAs
5	Air Force	Grand Forks AFB, ND	RQ-4 Global Hawk	Class D -> E -> A with nearby MOAs
6	Air Force	Holloman AFB, NM	MQ-1 Predator, MQ-9 Reaper	Class D with adjoining restricted area and MOA
7	Air Force	Creech AFB, NV	MQ-1 Predator, MQ-9 Reaper	Class D/E/A adjoining Restricted Area and MOA.
8	Air Force	Syracuse, NY (Wheeler Sack AAF)	ANG MQ-9 Reaper	Class D with adjoining restricted area and MOA
9	Army	Allen AAF, AK	Shadow	Class D with adjoining restricted airspace and MOA
10	Army	Bryant AAF - Fort Wainwright, AK	RQ-7B Shadow	Class D/E adjoining Restricted Area and MOA
11	Army	Cochise College, AZ	Hunter	Restricted airspace and nearby MOA

	Service	Location	Potential UA System	Notes
12	Army	El Mirage, CA	Sky Warrior	Class D/E adjoining restricted airspace and MOA
13	Army	Fort Stewart, GA	Hunter, Shadow, MQ-1C ERMP	Class D with adjoining restricted airspace and MOA
14	Army	Fort Riley, KS	MQ-1C ERMP, RQ-7B Shadow	Class D with adjoining restricted airspace and MOA
15	Army	Camp Claiborne, LA	RQ-7B Shadow	Class G/E adjoining warning areas and MOA
16	Army	Fort Polk, LA	RQ-7B Shadow	Class D with adjoining restricted airspace and MOA
17	Army	Hagler AAF - Camp Shelby, MS	RQ-7B Shadow	Class D/E adjoining restricted airspace and MOA
18	Army	Fort Bragg, NC	MQ-1C ERMP	Class C -> RA (operate out of Pope AFB) with nearby MOA
19	Army	Fort Drum, NY	RQ-7B Shadow	Class D with adjoining restricted airspace and MOA
20	Army	Fort Sill, OK	RQ-7B Shadow	Class D with adjoining restricted airspace and MOA
21	Army	Fort Hood, TX	MQ-1C ERMP MQ-1 Predator	Class D/E adjoining restricted airspace and MOA
22	USMC	Camp Lejeune, NC	RQ-7B Shadow, RQ-11B Raven, Marine STUAS, USSOCOM Wasp III	Class D with local MOAs
23	USMC	MCAS Cherry Pt, NC	RQ-7B Shadow	Class D with local MOAs
24	USMC	MCAS Yuma, AZ	RQ-7B Shadow	Class D with local MOAs
25	USMC	MCAGCC 29 Palms	RQ-7B Shadow, Marine STUAS	Class D/E with adjoining restricted airspace and local MOAs
26	USMC	Camp Pendleton, CA	RQ-7B Shadow, RQ-11B Raven, Marine STUAS, USSOCOM Wasp III	Class E with adjoining restricted airspace and MOAs
27	Navy	El Mirage, CA	MQ-1	Class D/E adjoining Restricted Area and MOA
28	Navy	Camp Roberts, CA	RQ-1	Class E/G underneath MOA
29	Navy	Beale AFB, CA	MQ-4C BAMS	Directed in CNO/CSAF Memo
30	Navy	Mayport, FL / Jacksonville, FL	MQ-8B Fire Scout NECC STUAS MQ-4C BAMS	Class D adjoining MOA and warning areas
31	Navy	Carrizo Springs, TX	Buster	
32	SOCOM	Choctaw NOLF, FL	ScanEagle	nearby MOA
33	SOCOM	Eglin AFB, FL	RQ-7B Shadow	Class D/E adjoins restricted airspace and nearby MOAs
34	SOCOM	Fort Campbell, KY	MQ-1C ERMP	Class D with adjoining restricted airspace and MOA
35	SOCOM	Pope AFB, NC	Viking 400	Class D with adjoining restricted airspace and MOA
36	SOCOM	Cannon AFB, NM	MQ-1 Predator MQ-9 Reaper EUAS Viking 400	Class D/E/A with nearby restricted area and MOA
37	SOCOM	Shaw AFB, SC	Viking 400	Class D with adjoining restricted airspace and MOA
38	SOCOM	Fort AP Hill, VA	EUAS Viking 400	Class G/E with nearby restricted area and MOA

LATERAL TRANSIT OPERATIONS

DoD UAS need to be capable of traversing portions of the NAS to conduct missions from one controlled airspace to another. The missions supported include aircraft deployment and ferry missions, surveillance, initial and recurring pilot/sensor operator training, and other operations requiring transit between UAS operations areas. Lateral transit operations can be between terminal, restricted, or any other controlled airspace. This requirement may exist at any any altitude, but primaily concerns transit through in Class E airspace (above 1200 ft AGL, but below 18,000 ft MSL).

Lateral transit operations are intended to be implemented in the near-term through established procedures (e.g. lost link, divert, recovery) and enabling technologies such as Ground Base Sense and Avoid (GBSAA). Validated radar technologies (in concert with defined set of flight and ATC coordination procedures) can ensure that a safe distance is provided beteween the UAS and other aircraft as it passes through the connecting transit volume (Figure 6).

Almost all the lateral transit operations in FY10 (Table 7) use a horizontal tunnelling method to transit Class E to restricted airspace. Half of the requested operations occur above 3,000 ft AGL but below 18,000 ft MSL, usually using chase planes to provide the capability to "see and avoid". The other half access Class E airspace below 3,000 ft AGL and transit an average of 6 NM using ground observers.

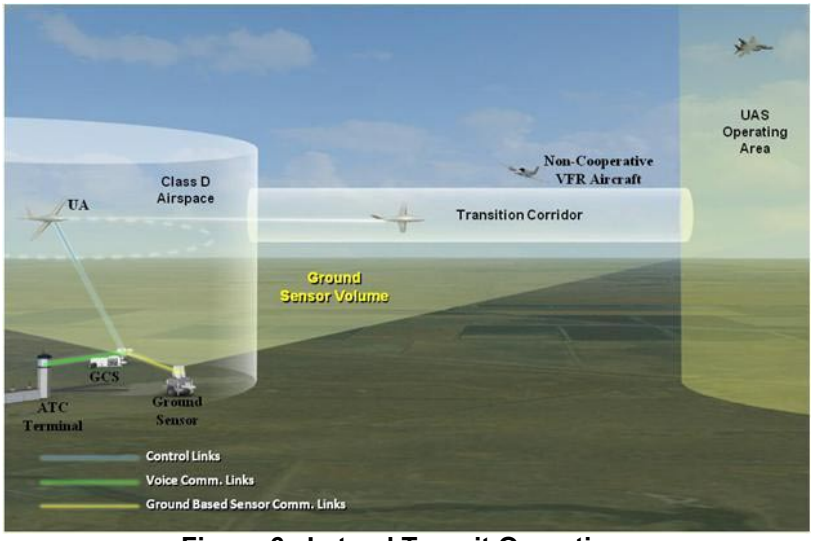


Figure 6. Lateral Transit Operations

Table 7: FY10 Lateral Transit Operation COAs

	Service	Location	UA System	Notes
1-2	Air Force	Creech AFB, NV	MQ-1 Predator, MQ-9 Reaper	Egress restricted area/Class D to Class E airspace; night ops disapproved
3-4	Air Force	El Mirage, CA	MQ-1 Predator, MQ-9 Reaper	Pattern work in Class G; transits Class E to restricted area; option to climb and egress RA to Class A and transit to Warning area; Chase & Visual Observer provisions apply; night ops denied
5	Air Force	SCLA, CA	ANG MQ-1 Predator	Chase aircraft required; routes for ops to two restricted areas
6	Army	Ft Greely, AK (Allen AAF)	Shadow	Class D/E/G. Night ops not approved.
7	Army	Fort Wainwright, AK (Firebird/Husky DZ)	RQ-7B Shadow	Class E/G. Night ops disapproved
8	Army	Fort Richardson, AK (Bryant AAF)	Shadow	Class E/G
9-10	Army	El Mirage, CA	Warrior / Sky Warrior	Mostly Class D, but pattern work conducted in Class G; includes Grey Butte; Class E transit to restricted area.

	Service	Location	UA System	Notes
11	USMC	Arlington, OR	ScanEagle	
12	Navy	Camp Roberts, CA	RQ-1	Non-joint use airfield; Class E/G pattern work; chase required (15K ft) for mitigations
13	Navy	El Mirage, CA	MQ-1	Transition patterns work in Class G/E; transition into restricted area; Chase & Visual Observer provisions apply.
14	Navy	Mayport, FL	MQ-8B Fire Scout	Chase plane required for divert to airfield
15	Navy	Moss Pt, MS	MQ-8B Fire Scout	Chase plane required for transit to Warning areas
16	SOCOM	Cannon AFB, NM	MQ-1 Predator	Uses multiple ground observers to fly 11 mile corridor; used in conjunction with Class D COA.

More lateral transit operations are expected for FY15 (Table 8) with a few differences. The general intent in many specific instances is to conduct operations in restricted areas but it is unclear where they would launch and recover. In all likelihood, these would require some form of lateral transit operation.

Table 8: Expected Lateral Transit Operations in FY15

	Service	Location	UA System	Notes
1	Air Force	Syracuse, NY (Wheeler Sack AAF, NY)	ANG MQ-9 Reaper	Launch and recovery operations from Ft Drum Class D adjoined to restricted area
2	Air Force	Ellington Field, TX (Polk AAF, LA)	MQ-1 Predator	Remote split ops Ellington Class D -> Houston Class B -> Class E -> Class A
3	Air Force	Fort Hood, TX	MQ-1 Predator	Fort Hood Class D -> E -> restricted area
4	Army	Pelham Range (Fort McClellan), AL	NG RQ-7B Shadow	Class G/E transit into RA
5	Army	Camp Claiborne, LA	RQ-7B Shadow	Joint use; Class G/E transit. Airport owned by LA dept of AG/Forestry
6	Army	Smoky Hill, KS	RQ-7B Shadow	Salina airport (joint use) only airport noted close by
7	Army	Fort Bliss, TX	RQ-7B Shadow	Fort Bliss Class C ->RIF Class D -> RA
8	Army	Fort AP Hill, VA	RQ-7B Shadow	Class G / E transit less than 1 mile to RA
9	USMC	Cherry Pt, NC (Cunningham Field)	RQ-7B Shadow	Class D to restricted area
10	USMC	MCAS Yuma, AZ	RQ-7B Shadow	Class D,E -> restricted area
11	Navy	NAS Jacksonville, FL	NECC STUAS	Jacksonville Class D; populated area surrounds ¾ Class D/E
12	Navy	Newport, RI	NECC STUAS	Joint use Newport Class E surface area
13	Navy	Pax River, MD		Connecting Pax River/Dahlgreen VA/A.PHill
14	Navy	Norfolk, VA	MQ-8B Fire Scout	Class D -> E -> restricted/ warning area
15	SOCOM	Eglin AFB, FL	RQ-7B Shadow	Joint Use Class D to restricted a/s; routes transit Eglin class D/E to ingress restricted areas
16	SOCOM	Cannon AFB, NM	EUAS Viking 400	Cannon Class D -> E -> restricted area
17	SOCOM	Fort AP Hill, VA	EUAS Viking 400	Class G = E -> restricted area, less than 1 mile transit to RA
18	SOCOM	Fentress NALF, VA	Viking	Restricted airspace 8 miles east, requires Class E transit for ingress
19	SOCOM	Louisville, KY	EUAS Viking 400	Only restricted area near Louisville is Fort Knox; Viking requires runway surface
20	SOCOM	Portland, OR	EUAS Viking 400	Unclear how Viking is to operate, but probably will require terminal and lateral transit access profiles.
21	SOCOM	NAB Little Creek, VA	PUMA AE	Norfolk Class C airspace

VERTICAL TRANSIT (CYLINDER) OPERATIONS

DoD UAS need to be capable of conducting a climb or decent to / from Class A controlled airspace through Class E or restricted airspace. The need is to deploy, operate, and ferry aircraft to conduct various missions. Vertical transit (or "Cylinder") operations require a climb/descent to/from terminal areas to Class A (controlled) airspace.

As with the Lateral transit operations, safe passage through the connecting transit volume of airspace would be ensured by the utilization of validated radar technologies (in concert with defined set of flight and ATC coordination procedures) designed to ensure that a safe distance is provided beteween the UAS and other aircraft.

Most vertical transit operations currently depart/arrive and transit to Class A through restricted/warning areas (see Table 9). Only one COA currently requires transit through Class E airspace and departs/arrives in Class C airspace. In FY15, it is expected that all new vertical transit operations will require transit through Class E airspace (Table 10).

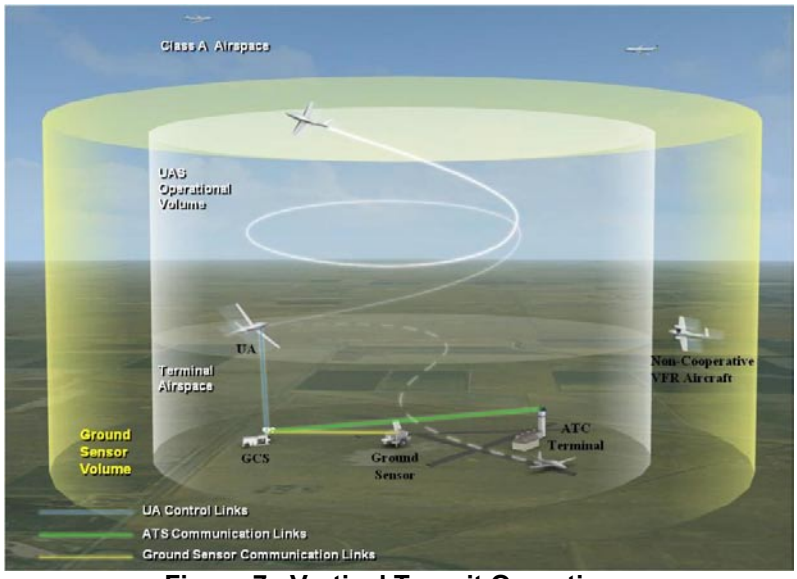


Figure 7. Vertical Transit Operations

Table 9: FY10 Vertical Transit Operation COAs

	Service	Location	UA System	Notes
1-4	Air Force	Creech AFB, NV	MQ-9 Reaper; MQ-1 Predator	Exits restricted area into Class A; conducts mission segment; option to transit to restricted area
				Egress/ingress RA to Desert/Reveille MOA above 11,000 MSL and returns; chase aircraft provisions apply.
5	Air Force	Beale AFB, CA	RQ-4 Global Hawk	National COA is not site specific; other USAF Global Hawk may utilize
6	Navy	PAX River, MD	Global Hawk Maritime Demonstrator (GHMD)	Agreement with unit and all affected Air Route Traffic Control Centers.

Table 10: Expected Vertical Transit Operations in FY15

	Service	Location	UA System	Notes
1	Air Force	Fargo, ND	ANG MQ-1 Predator	Joint Use. Class D -> E -> A
2	Air Force	Grand Forks AFB, ND	RQ-4 Global Hawk	Class D -> E -> A
3	Navy	Beale AFB, CA	MQ-4C BAMS	Class D -> E-> A
4	Navy	NAS Mayport, FL	MQ-4C BAMS	Initial training base – simulation and supports C2F and C4F operations
5	SOCOM	Cannon AFB, NM	MQ-9 Reaper	Class D -> E -> A, or use RA

DYNAMIC OPERATIONS

Dynamic operations satisfy those mission needs that require robust access to the NAS, international, and foreign airspace comparable to today's manned aircraft. The mission needs require flexibility in meeting rapidly changing contingency requirements, real-time scheduling/execution of UAS flights, and near-complete integration of suitably-capable UAS with manned aviation platforms. Dynamic operations will require autonomous and reliable self-separation and collision avoidance to enable the proponent of an appropriately equipped UAS to file a real-time flight plan and then perform the activities listed in that flight plan (see Figure 8).

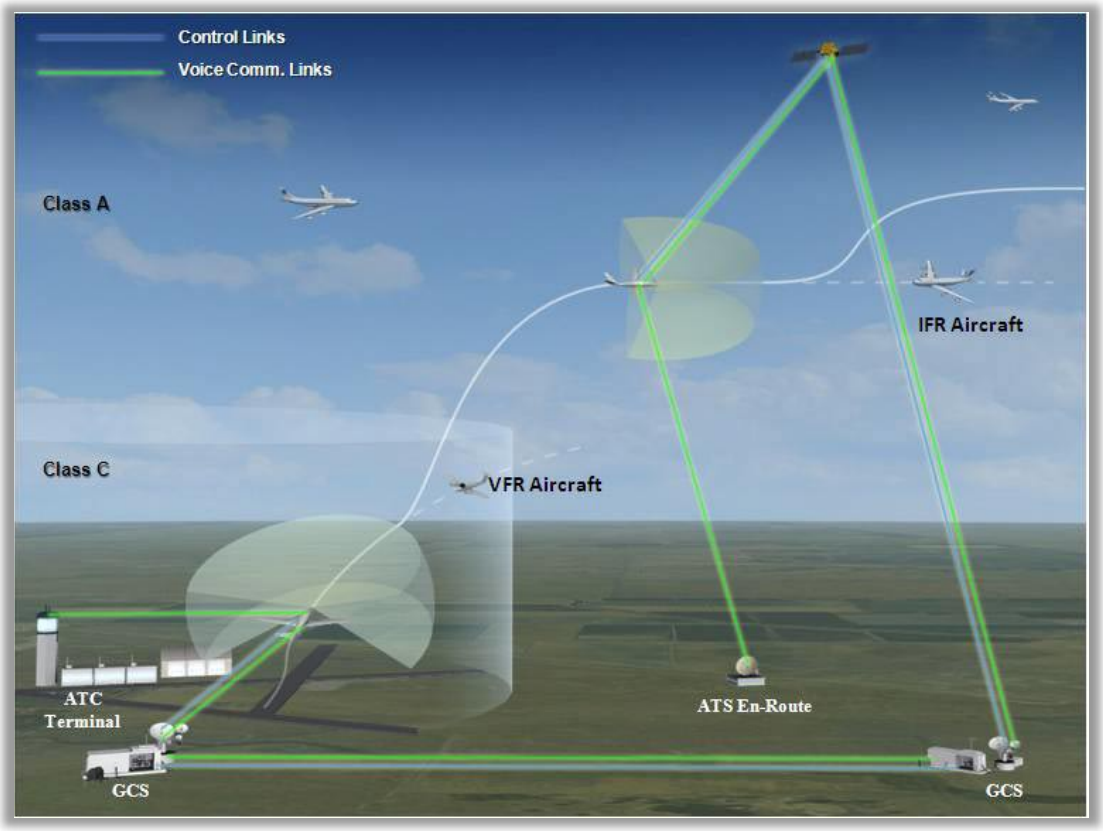


Figure 8. Dynamic Operations

There are no true dynamic operations allowable today or planned by FY15. DoD is developing an airborne sense and avoid (ABSAA) system to autonously provide safe separation and avoid collision with other aircraft. The Air Force Global Hawk and Navy Broad Area Maritime Surveillance (BAMS) programs are the first envisioned to fly a true dynamic profile.

Table 11: Current and Future UAS Beddown Locations and Operating Areas

LOCATION	SERVICE/UAS/GROUP	UNITS		Access Category	Comments
		FY10	FY15		
ALABAMA					
Pelham Range (Fort McClellan), AL	Army NG RQ-7B Shadow	(None)	1 Platoon	Lateral	Class G/E into RA
Redstone AAF, AL	Army Shadow	(None)	(None)	Terminal	Night ops for launch/recovery only with conditions.
Ft Rucker, AL	Army RQ-7B Shadow Army RQ-11B Raven	(None)	(None)	None	All ops conducted in restricted area
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	1 BCT Set	LOS	Each BCT gets 15 or 17 Group 1 systems which are further pushed down to companies in the BCT. As National Guard units are distributed throughout the state, the various Group 1 systems can be expected to be similarly distributed.
ALASKA					
Fort Richardson, AK / Bryant AAF, AK	Army RQ-7B Shadow Army RQ-11B Raven	1 Platoon 1 BCT Set	1 Platoon 1 BCT Set	(None)	
Fort Wainwright, AK (Firebird/Husky Drop Zone)	Army RQ-7B Shadow Army RQ-11B Raven	1 Platoon 1 BCT Set	1 Platoon 1 BCT Set	Lateral / Terminal	Night ops disapproved
Ft Greely, AK (Allen AAF)	Army Shadow	(None)	(None)	Terminal	Night ops not approved.
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	(None)	TBD	
ARIZONA					
Davis-Monthan AFB, AZ (Libby AAF, AZ)	ANG MQ-1 Predator	1 ANG Squadron	1 ANG Squadron	(None)	
Fort Huachuca, AZ	Army MQ-1C ERMP Army MQ-5B Hunter Army RQ-7B Shadow Marine Group 4 UAS Marine RQ-7B Shadow Marine STUAS USSOCOM RQ-7B Shadow	Initial Training Initial Training Initial Training (None) Initial Training (None) Initial Training	Initial Training Initial Training Initial Training Initial Training Initial Training Initial Training Initial Training	Terminal	
Cochise College, AZ	Army MQ-5B Hunter	(None)	(None)	Terminal	1) Hunter Contract Operator

AAF – Army Air Field
AFSOC – Air Force Special Ops Cmd
ANG – Air National Guard
BCT – Brigade Combat Team
MARSOC – USMC Special Ops Cmd
RA – Restricted Airspace
SFG – Special Forces Groups
TBD – To Be Determined
USAG – U.S. Army Guard
USSOCOM – U.S. Special Ops Command
Unk - Unknown

LOCATION	SERVICE/UAS/GROUP	UNITS		Access Category	Comments
		FY10	FY15		
					Training; 2) Chase aircraft provision 3) Joint Use Class G airfield
Yuma, AZ	Marine RQ-7B Shadow	1 Squadron	1 Squadron	Lateral	
ARKANSAS					
Fort Chaffee, AR	Army NG RQ-7B Shadow	(None)	2 Platoons	(None)	Restricted Airspace only
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	2 BCT Sets	LOS	
CALIFORNIA					
Beale AFB, CA	Air Force RQ-4 Global Hawk Air Force RQ-4 Global Hawk Navy MQ-4C BAMS	Initial Training 1 Squadron	Initial Training 1 Squadron	Vertical / MOA	Other USAF Global Hawk may utilize current COAs
Camp Pendleton, CA	USMC RQ-11B Raven USMC STUAS USSOCOM RQ-11B Raven USSOCOM Wasp III	I MEF units MARSOC MARSOC	I MEF units MARSOC MARSOC	(None)	Operations in RA only
Camp Roberts, CA	Army NG RQ-7B Shadow	1 Platoon	3 Platoons	(None)	
	Navy RQ-1 Predator	(None)	(None)	Lateral	Non-joint use airfield; chase required (15K) for mitigations in one segment; Class E/G pattern work.
Edwards AFB, CA	USSOCOM Global Observer	(None)	(None)	(None)	
El Mirage, CA	Army Warrior / Sky Warrior	Contractor Facility	Contractor Facility	Terminal / Lateral	Pattern work conducted in Class G; includes Grey Butte; transits to RA in Class E.
	Air Force MQ-1 Air Force MQ-9	Contractor Facility	Contractor Facility	Lateral	Pattern work in Class G; transits Class E to RA; option to climb and egress RA to Class A; transit to Warning area; Chase & Visual Observer provisions apply; night ops not approved.
	Navy MQ-1	Contractor Facility	Contractor Facility	Lateral	Transition patterns work in Class G/E; transition into RA; Chase & Visual Observer provisions apply.
Fort Irwin, CA	USSOCOM RQ-11B Raven USSOCOM Wasp III	(None)	NSWG1/SBT Detachment	(None)	

AAF – Army Air Field
AFSOC – Air Force Special Ops Cmd
ANG – Air National Guard
BCT – Brigade Combat Team
MARSOC – USMC Special Ops Cmd
RA – Restricted Airspace
SFG – Special Forces Groups
TBD – To Be Determined
USAG – U.S. Army Guard
USSOCOM – U.S. Special Ops Command
Unk - Unknown

LOCATION	SERVICE/UAS/GROUP	UNITS		Access Category	Comments
		FY10	FY15		
March ARB, CA (LRE at Southern CA Logistics Airport)	ANG MQ-1 Predator ANG MQ-1 Predator	FTU 1 Squadron	FTU 1 Squadron	Lateral	Chase aircraft; routes for ops in 2 RA; Class D pattern.
Marine Corps Air Ground Combat Center (MCAGCC) 29 Palms, CA	Marine RQ-7B Shadow Marine STUAS Marine STUAS Army RQ-7B Shadow	2 Squadrons Marine Expeditionary Force units 1 Platoon	2 Squadrons (embedded in 2 Squadrons) 3 Platoons	(None)	Operations in restricted airspace only
NAB Coronado, CA	USSOCOM PUMA AE	(None)	NSWG1/SBT Detachment	Terminal	
Pt Mugu, CA	Navy MQ-8B Fire Scout	(None)	Central Repository	(None)	Training planned in simulator and live fly at sea
San Clemente Island, CA	USSOCOM RQ-11B Raven	(None)	NSWG1/SBT Detachment	Terminal	
San Diego, CA	Navy STUAS Navy NECC STUAS Navy NECC Silver Fox Navy NECC Silver Fox	(None) (None) EOD Unit 3 Dets	Initial Training 3 Systems EOD Unit 9 Dets	Terminal	STUAS
Taft / Brenen Field, CA	USSOCOM Puma USSOCOM Wasp	(None)	(None)	LOS	Puma approved for 600 and 400 AGL only. Wasp approved for 400 AGL. Site located within 30 NM of LAX
Vandenberg AFB, CA	USSOCOM EUAS Viking 400 USSOCOM RQ-11B Rave	(None) (None)	NSWC or AFSOC TBD on numbers AFSOC STS	Terminal	
Victorville, CA	Army A-160T	(None)	(None)	Terminal	Contractor test site
Simi Valley, CA	Army RQ-11B Raven	(None)	(None)	LOS	
USSOCOM West Coast Training Center: San Clemente Island, CA or China Lake, CA	USSOCOM EUAS Viking 400 USSOCOM PUMA AE USSOCOM RQ-11B Raven USSOCOM Wasp III USSOCOM Anubis	(None)	USSOCOM West Coast Training Center	Terminal	
Bridgeport, CA (MC Mountain Warfare Training Center)	Marine small UAS	(None)	TBD	LOS	
Location Unknown (Dispersed)	Army NG RQ-11B Raven	1 BCT Set	3 BCT Sets	TBD	

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		FY10	FY15		
COLORADO					
U.S. Air Force Academy (USAFA) Airstrip, CO	AFSOC Viking	USAFA	USAFA	LOS	Depart from Aardvark airstrip located approximately 5 miles north of KAFF airfield
Ft. Carson, CO (Pinon Canyon)	Army RQ-7B Shadow Army RQ-11B Raven	5 Platoons 4 BCT Sets	6 Platoons 4 BCT Sets	LOS	Most ops conducted within restricted airspace
Location Unknown (Dispersed)	Army NG RQ-11B Raven	1 BCT Set	1 BCT Set	TBD	
FLORIDA					
Camp Blanding, FL	Army NG RQ-7B Shadow	(None)	1 Platoon	(None)	
Choctaw Naval Outlying Field (NOLF), FL	Army RQ-7B Shadow USSOCOM RQ-11B Raven USSOCOM Anubis	USSOCOM East Coast Training Center (Raven/Wasp Only)	USSOCOM East Coast Training Center (PUMA AE, Raven, Wasp, Anubis)	Terminal	Multiple simultaneous UAS allowed—specific training locations for Group 1 UAS.
Eglin AFB, FL	Army RQ-7B Shadow USSOCOM NG RQ-7B Shadow USSOCOM NG RQ-11B Raven	None (None)	1 Platoon 1 Platoon 1 SFG Set	Lateral	
Hurlburt Field, FL	USSOCOM EUAS Viking 400 USSOCOM PUMA AE USSOCOM RQ-11B Raven USSOCOM Wasp III USSOCOM Anubis	(None) 2 Squadrons (Wasp only)	Squadron 2 Squadrons (each with PUMA AE, Raven, Wasp III, and Anubis)	(None)	Restricted Airspace operations only
NAS Jacksonville, FL	Navy MQ-4C BAMS	(None)	Initial Training Squadron	Vertical	Initial training base – sim only until at-sea phase
	Navy NECC STUAS	(None)	NECC Detachment	Lateral	Jacksonville Class D
NS Mayport, FL	Navy MQ-8B Fire Scout	(None)	Central Repository	(None)	Train using simulation and fly only at sea.
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	1 BCT Set	LOS	
GEORGIA					
Fort Benning, GA	Army RQ-11B Raven USSOCOM RQ-7B Shadow USSOCOM RQ-11B Raven	School House 1 Platoon 1 Ranger Set	School House 1 Platoon 1 Ranger Set	TBD	Restricted Airspace operations only

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		FY10	FY15		
Fort Stewart, GA	Army MQ-1C ERMP	(None)	1 Company	Terminal	Fort Stewart Joint Use; Class D -> RA
	Army MQ-5B Hunter	1 Company	1 Company	Terminal	1) Suspended 10 Apr 09 due to accident; resumed 7 Jul 09; 2) Night ops for launch/recovery only with conditions; 3) Joint-Use Class D but separate ops airfield.
	Army RQ-7B Shadow	3 Platoons	5 Platoons	Terminal	1) Night ops for launch / recovery only with conditions; 2) Joint-Use Class D.
	Army RQ-11B Raven	3 BCT Sets	3 BCT Sets	(None)	
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	2 BCT Set	LOS	
HAWAII					
Kaneohe, HI	Marine RQ-11B Raven Marine RQ-7B Shadow	3rd Marine Regiment Units	3rd Marine Regiment Units	Terminal	1) Ops within 30 NM of HNL; 2) Class D/E ops limited 3) Class G ops at Bellows training area.
Schofield Barracks, HI (Wheeler AAF)	Army RQ-7B Shadow	2 Platoons	3 Platoons	Terminal	Night ops for launch/recovery permitted with conditions.
	Army RQ-11B Raven	2 BCT Sets	2 BCT Sets	(None)	
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	1 BCT Set	LOS	
IDAHO					
Orchard, ID	Army NG RQ-11B Raven	1 BCT Set	1 BCT Set	TBD	
IOWA					
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	1 BCT Set	LOS	
ILLINOIS					
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	2 BCT Sets	LOS	
INDIANA					
Camp Atterbury, IN	Army RQ-7B Shadow	(None)	3 Platoons	(None)	
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	2 BCT Sets	LOS	

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		FY10	FY15		
KANSAS					
Fort Riley, KS	Army MQ-1C ERMP Army RQ-7B Shadow Army RQ-11B Raven	(None) 3 Platoons 3 BCT Sets	1 Company 3 Platoons 3 BCT Sets	Terminal	Class D -> RA
Smoky Hill, KS	Army RQ-7B Shadow	(None)	1 Platoon	Lateral	
Location Unknown (Dispersed)	Army NG RQ-11B Raven	1 BCT Sets	1 BCT Sets	LOS	
KENTUCKY					
Fort Campbell, KY	Army RQ-7B Shadow Army RQ-11B Raven USSOCOM MQ-1C ERMP USSOCOM RQ-7B Shadow USSOCOM RQ-11B Raven	(None) 5 Platoons 1 Platoon 4 BCT Sets 1 SFG Set	2 Companies 5 Platoons 1 Platoon 4 BCT Sets 1 SFG Set	Terminal	
Fort Knox, KY	Army RQ-7B Shadow Army RQ-11B Raven USSOCOM RQ-11B Raven	1 Platoon 1 BCT Set (None)	1 Platoon 1 BCT Set 1 NSWG SBT Det	Terminal	Shadow. Class D -> RA
Louisville, KY (ANG)	USSOCOM EUAS Viking 400 USSOCOM PUMA AE USSOCOM RQ-11B Raven USSOCOM Wasp III USSOCOM Anubis	(None) (None) (None) ANG STS Squadron (None)	AFSOC Squadron ANG STS Squadron	TBD	Still determining how Viking is to operate, but probably will require terminal and lateral transit access profiles.
LOUISIANA					
Fort Polk, LA	Army RQ-7B Shadow Army RQ-11B Raven	1 Platoon 1 BCT Set	1 Platoon 1 BCT Set	Terminal	Night ops for launch and recovery only with conditions; chase required for mitigations in one segment. Self airstrip in Class G.
	ANG Predator	Unk	Unk	Terminal	Squadron is located at Ellington Field, TX, but plan is to fly at Fort Polk until approval can be attained to fly at home station.
Camp Claiborne, LA	Army RQ-7B Shadow	1 Platoon	1 Platoon	Lateral	
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	1 BCT Set	LOS	
MARYLAND					
Aberdeen Proving Grounds, MD	USSOCOM RQ-11B Raven	(None)	1 NSWG SBT Detachment	(None)	

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		FY10	FY15		
PAX River (Webster Field), MD	Navy MQ-8B Fire Scout USSOCOM EUAS Viking 400 Army NG RQ-7B Shadow Navy Global Hawk Maritime Demonstrator (GHMD)	(None) (None) 2 Platoons	Initial Training Squadron 2 Platoons	Vertical	
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	2 BCT Sets	LOS	
MASSACHUSETTS					
Camp Edwards, MA	Army RQ-7B Shadow	(None)	1 Platoon	Terminal	Class D -> RA (operation out of OTIS AFB)
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	1 BCT Set	LOS	
MICHIGAN					
Camp Grayling, MI	Army RQ-7B Shadow	1 Platoon	1 Platoon	Terminal	
Location Unknown (Dispersed)	Army NG RQ-11B Raven	1 BCT Set	1 BCT Set	TBD	
MINNESOTA					
Camp Ripley, MN	Army RQ-7B Shadow	1 Platoon	2 Platoons	Terminal	Night ops for launch/recovery permitted with conditions.
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	2 BCT Sets	LOS	
MISSISSIPPI					
Camp Shelby, MS (Hagler AAF)	Army RQ-7B Shadow	(None)	1 Platoon	Terminal	Night ops disapproved
Moss Point, MS (Trent Lott Airfield)	Navy MQ-8B Fire Scout	(None)	Unk	Lateral	
Stennis Space Center, MS	USSOCOM RQ-11B Raven USSOCOM Wasp USSOCOM PUMA AE	Naval Special Warfare Group (NSWG) Special Boat Team (SBT) Detachment	NSWG SBT Detachment (None)	LOS	FY10: Wasp & Raven approved at 400 AGL; night ops denied.
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	1 BCT Set	LOS	
NEVADA					
Creech AFB, NV	Air Force MQ-9 Reaper Air Force MQ-1 Predator	1 Squadron 3 Squadron	1 Squadron 3 Squadron	Vertical	Exits RA into Class A; airspace transits to restricted area and returns; option to exit restricted area into Class

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		FY10	FY15		
					E and land Class G.
				Vertical	Egress/ingress RA to Desert/Reveille MOA above 11,000 MSL and returns; chase aircraft provisions apply.
				Lateral	Egress restricted area/Class D to Class E airspace for pattern work at Desert Rock; night ops denied.
NEW JERSEY					
Warren Range, NJ	Army RQ-7B Shadow	(None)	1 Platoon	(None)	
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	1 BCT Set	LOS	
NEW MEXICO					
Cannon AFB, NM	USSOCOM MQ-9 Reaper	(None)	1 Squadron	TBD-Vertical or Lateral	Class D to E to A, or RA
	USSOCOM MQ-1 Predator	1 Squadron	1 Squadron	Terminal / Lateral	Terminal - under provisions of DoD-FAA MoA Lateral - Uses multiple ground observers to fly 11 mile corridor; used in conjunction with Class D COA.
	USSOCOM EUAS Viking 400	(None)	1 Squadron	Lateral	
	USSOCOM Wasp III	(None)	1 Squadron	LOS	
	USSOCOM Anubis	(None)		(None)	
Holloman AFB, NM	Air Force MQ-1 Predator Air Force MQ-9 Reaper	1 Squadron (None)	1 Squadron 1 Squadron	Terminal	
Laguna Pueblo, NM / Cubero, NM	USN T-Hawk (MAV) USA gMAV	(None)	(None)	LOS	Night training requested ISO JUONS but disapproved.
Santa Fe, NM (Playas)	USAG Raven	(None)	(None)	LOS	Counter Narcotics Ops
NEW YORK					
Fort Drum, NY	Army RQ-7B Shadow	3 Platoons	4 Platoons	Terminal	Night ops for launch / recovery permitted with conditions.
	Army RQ-11B Raven	3 BCT Sets	3 BCT Sets	(None)	
Syracuse, NY (Wheeler Sack AAF, NY)	ANG MQ-9 Reaper	1 Squadron	1 Squadron	Terminal / Lateral	Launch and recovery operations from Ft Drum

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		FY10	FY15		
					Class D adjoined to RA
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	1 BCT Set	LOS	
NORTH CAROLINA					
MCAS Cherry Point, NC / Bogue Field, NC	Marine RQ-7B Shadow Marine STUAS	1 Squadron (None)	1 Squadron	Terminal / Lateral	Night ops for launch/recovery permitted with conditions. Training planned in simulator and live fly at sea
Camp Lejuene, NC	Marine RQ-11B Raven Marine STUAS USSOCOM RQ-11B Raven USSOCOM Wasp III	II MEF Units MARSOC MARSOC	II MEF Units MARSOC MARSOC	(None)	Operations in Restricted Airspace only
Piney Island, NC	USSOCOM RQ-11B Raven	NSWG SBT Detachment	NSWG SBT Detachment	(None)	
Fort Bragg, NC	Army MQ-1C ERMP Army RQ-7B Shadow Army RQ-11B Raven USSOCOM RQ-7B Shadow USSOCOM RQ-11B Raven	(None) 5 Platoons 4 BCT Sets 2 Platoons 2 SFG Sets	1 Company 6 Platoons 4 BCT Sets 2 Platoons 2 SFG Sets	ERMP - Terminal	
Pope AFB, NC	USSOCOM EUAS Viking 400 USSOCOM PUMA AE USSOCOM RQ-11B Raven USSOCOM Wasp III USSOCOM Anubis	(None) 2 Squadrons (Raven, Wasp only)	Squadron 2 Squadrons (each with PUMA AE, Raven, Wasp, Anubis)	Viking - Terminal	
Location Unknown (Dispersed)	Army NG RQ-11B Raven	1 BCT Set	1 BCT Set	TBD	
NORTH DAKOTA					
Fargo, ND (Grand Forks AFB)	ANG MQ-1 Predator	Squadron	Squadron	Vertical	Joint Use. Class D to E to A
Grand Forks AFB, ND	Air Force RQ-4 Global Hawk	(None)	Squadron	Vertical	Class D to E to A
OKLAHOMA					
Fort Sill, OK	Army RQ-7B Shadow	(None)	2 Platoons	Terminal	Class D -> RA
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	2 BCT Sets	LOS	
OREGON					
Arlington, OR	Marine ScanEagle	Contractor training	1 ANG Squadron (Raven, Wasp only)	Lateral	
Boardman, OR	Army NG RQ-7B Shadow	1 Platoon	1 Platoon	(None)	
Portland, OR (ANG)	USSOCOM EUAS Viking 400	(None)	NSWG SBT	TBD -	Unclear how Viking is to

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		FY10	FY15		
	USSOCOM PUMA AE USSOCOM RQ-11B Raven USSOCOM Wasp III USSOCOM Anubis	1 ANG Squadron (Raven, Wasp only)	Detachment 1 ANG Squadron (PUMA AE, Raven, Wasp, Anubis)	Terminal / Lateral	operate, but probably will require terminal and lateral transit access profiles.
Location Unknown (Dispersed)	Army NG RQ-11B Raven	1 BCT Set	1 BCT Set	TBD	
PENNSYLVANIA					
Fort Indiantown Gap, PA	Army RQ-7B Shadow	1 Platoon	3 Platoons	Terminal	Night ops for launch/recovery permitted with conditions.
Unknown Location (Dispersed)	Army NG RQ-11B Raven	1 BCT Set	3 BCT Sets	TBD	
RHODE ISLAND					
Newport, RI	Navy Expeditionary Combat Command (NECC) STUAS	(None)	Navy NECC Unit	Lateral	
SOUTH CAROLINA					
Shaw AFB, SC	USSOCOM EUAS Viking 400 USSOCOM RQ-11B Raven	(None) Squadron	Squadron Squadron	Terminal	Viking
TEXAS					
Ellington Field, TX (Polk AAF, LA)	ANG MQ-1 Predator	1 Squadron	1 Squadron	Lateral	Remote split ops Ellington Class D -> Houston Class B -> Class E -> Class A
Fort Bliss, TX	Army RQ-7B Shadow Army RQ-11B Raven	4 Platoons 4 BCT Sets	4 Platoons 4 BCT Sets	Lateral	Fort Bliss Class C ->RIF Class D -> RA
Fort Hood, TX	ANG MQ-1 Predator	(None)	Unk	Lateral	Class D -> E -> RA
	Army MQ-1C ERMP	(None)	2 Companies	Terminal / Lateral	Class D -> E -> RA
	Army MQ-5B Hunter	1 Company	1 Company	Lateral	Robert Gray AAF – Night ops for launch/recovery only with conditions; joint use airfield.
	Army RQ-7B Shadow	6 Platoons	9 Platoons	(None)	Uses airfield inside RA
	Army RQ-11B Raven	4 BCT Sets	4 BCT Sets	(None)	Fly in restricted airspace only
Carrizo Springs, TX	USN Buster	(None)	(None)	LOS	Night flying denied
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	4 BCT Sets	LOS	
Utah					

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Dugway, UT	Army RQ-7B Shadow	(None)	5 Platoons	TBD	rapid integration center in restricted airspace – under development
Location Unknown (Dispersed)	Army RQ-11B Raven	(None)	1 BCT Set	LOS	
VIRGINIA					
Fort AP Hill, VA	Army RQ-7B Shadow Army RMAX USSOCOM EUAS Viking 400 USSOCOM ScanEagle USSOCOM RQ-11B Raven	(None) (None) (None) NSWC SBT Detachment	1 Platoon (None) Squadron NSWC SBT Detachment	Terminal / Lateral	
Fentress NALF, VA	USSOCOM EUAS Viking 400	(None)	Squadron	Lateral	
	USSOCOM Raven	NSWC SBT Detachment	NSWC SBT Detachment	LOS	Approved for at or below 750 AGL; Class E ops within 2.5 NM of runway; during Oceana approach hrs only.
Fort Story, VA	USSOCOM RQ-11B Raven USSOCOM Wasp	SBT Detachment	SBT Detachment	(None)	Includes Class E & G airspace 700/1000 AGL and below; ops Area A starts at 5.5 NM from approach end of Norfolk airport runway 23
NAB Little Creek, VA	USSOCOM PUMA AE	(None)	Unk	TBD	Norfolk Class C airspace
Norfolk, VA	Navy MQ-8B Fire Scout Navy NECC Silver Fox Navy NECC PUMA AE Navy NECC Aqua Wasp	(None) Riverine Group (4 systems) (None)	(None) Riverine Group (6 systems)	Fire Scout - Lateral Terminal / LOS	
Fort Pickett, VA	Army RQ-7B Shadow	(None)	(None)	Lateral	
Portsmouth, VA	Navy NECC STUAS	(None)		Terminal	
Yorktown, VA	Navy NECC PUMA AE Navy NECC (Aqua) Wasp	(None) (None)	Riverine Group (3 systems)	LOS	
Felker AAF, VA (Ft Eustis)	Army Vigilante VTOL	Unk	Unk	Terminal	Class D ops (11 hrs) non-joint use
Quantico, VA	USMC Raven, Shrike, WASP III	Individual vehicle testing & development	TBD	LOS	Marine Corps Combat Development Command. Ops currently conducted within restricted airspace
Unknown Location: Dispersed	Army NG RQ-11B Raven	(None)	1 BCT Set	LOS	
WASHINGTON					

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Everett, WA	Navy NECC STUAS	(None)	Squadron	Terminal	
Fort Lewis, WA	Army RQ-7B Shadow Army RQ-11B Raven USSOCOM RQ-7B Shadow USSOCOM RQ-11B Raven	3 Platoons 3 BCT Sets 1 Platoon 1 SFG Set	4 Platoons 3 BCT Sets 1 Platoon 1 SFG Set	(None)	Operate in Restricted Airspace only
McChord AFB, WA	USSOCOM EUAS Viking 400 USSOCOM PUMA AE USSOCOM RQ-11B Raven USSOCOM Wasp III USSOCOM Anubis	(None) 1 ANG Squadron (Raven, Wasp only)	Squadron 1 ANG Squadron (PUMA AE, Raven, Wasp, Anubis)	Terminal	Viking
Yakima, WA	Army RQ-7B Shadow	1 Platoon	1 Platoon	(None)	Operate in RA Only
Location Unknown (Dispersed)	Army NG RQ-11B Raven	1 BCT Set	2 BCT Sets	LOS	
WISCONSIN					
Fort McCoy, WI	Army RQ-7B Shadow	(None)	1 Platoon	(None)	
Location Unknown (Dispersed)	Army NG RQ-11B Raven	(None)	1 BCT Set	LOS	

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ACRONYM LIST

AAF	Army Air Field
ABSAA	Airborne Sense and Avoid
AFB	Air Force Base
ANG	Air National Guard
ARB	Air Reserve Base
ARC	Aviation Rulemaking Committee
AGL	Above Ground Level
AFSOC	Air Force Special Operations Command
BAMS	Broad Area Maritime Surveillance
BCT	Brigade Combat Team (15 Units per set)
COA	Certificate of Waiver or Authorization
CNO	Chief of Naval Operations
CSAF	Chief of Staff of the United States Air Force
DoD	Department of Defense
DZ	Drop Zone
ERMP	Extended Range, Multi-Purpose
EUAS	Expeditionary Unmanned Aircraft System
FAA	Federal Aviation Administration
GBSAA	Ground Based Sense and Avoid
HNL	Honolulu International Airport
IFR	Instrument Flight Rules
JUONS	Joint Urgent Operational Needs
LOS	Line of Sight
LRE	Launch and Recovery Element
MARSOC	Marine Corps Forces Special Operations Command
MCAS	Marine Corps Air Station
MCAGCC	Marine Corps Air Ground Combat Center
MOA	Military Operations Area
MoA	Memorandum of Agreement
NAB	Naval Amphibious Base
NALF	Naval Auxiliary Landing Field
NAS	National Airspace System
NECC	Navy Expeditionary Combat Command
NG	National Guard
NM	Nautical Miles
NOLF	Naval Outlying Field
NSWG	Naval Special Warfare Group
RA	Restricted Airspace
SAN	San Diego International Airport
SBT	Special Boat Team
SCLA	Southern California Logistics Airport
SFAR	Special Federal Aviation Regulation
SFG	Special Forces Groups
SOCOM	Special Operations Command
STUAS	Small Tactical Unmanned Aircraft System
TBD	To Be Determined
UAS	Unmanned Aircraft System(s)
USAF	United States Air Force
USAFA	United States Air Force Academy
USAG	United States Army Guard
USMC	United States Marine Corps
USSOCOM	United States Special Operations Command
VFR	Visual Flight Rules