NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

APPLICABILITY OF UNMANNED AERIAL SYSTEMS TO HOMELAND DEFENSE MISSIONS

by

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December 2006

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY ***(Leave blank)***	**2. REPORT DATE** December 2006	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE Applicability of Unmanned Aerial Systems to Homeland Defense Missions		**5. FUNDING NUMBERS**	
6. AUTHOR(S) John C. DeVane			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000		**8. PERFORMING ORGANIZATION REPORT NUMBER**	
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A		**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited		**12b. DISTRIBUTION CODE**	

13. ABSTRACT (maximum 200 words)

Battlefield success of Unmanned Aerial Systems (UAS) prompted Department of Defense and Department of Homeland Security leaders to examine their possible applicability to homeland defense missions within the *National Strategy for Homeland Security*. The N*ational Strategy for Homeland Security* incorporates all levels of government to include law enforcement agencies and the military, the predominant owner and operator of UASs. The military, however, is restricted in its domestic role by the Posse Comitatus Act, and is therefore limited in its domestic employment of UASs. In order to determine the applicability of UASs to homeland defense missions, it is necessary to examine the capabilities of available UASs, to match them with mission requirements, and determine the legality of where they can be used and who can operate them. A policy that places combat UAS capability with Title 10 military forces and homeland defense mission capability with Title 32 and law enforcement agencies will fulfill the goals stated in the national strategy and function within the current legal framework.

14. SUBJECT TERMS Unmanned Aerial Vehicle, Unmanned Aerial System, UAV, UAS, Homeland Defense, Homeland Security, 9/11, Terrorism, Intelligence Surveillance and Reconnaissance, ISR, Global War on Terror			**15. NUMBER OF PAGES** 101
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UL

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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APPLICABILITY OF UNMANNED AERIAL SYSTEMS TO HOMELAND DEFENSE MISSIONS

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Submitted in partial fulfillment of the
requirements for the degree of

**MASTER OF ARTS IN SECURITY STUDIES
(HOMELAND SECURITY AND DEFENSE)**

from the

**NAVAL POSTGRADUATE SCHOOL
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ABSTRACT

Battlefield success of Unmanned Aerial Systems (UAS) prompted Department of Defense and Department of Homeland Security leaders to examine their possible applicability to homeland defense missions within the *National Strategy for Homeland Security*. The N*ational Strategy for Homeland Security* incorporates all levels of government to include law enforcement agencies and the military, the predominant owner and operator of UASs. The military, however, is restricted in its domestic role by the Posse Comitatus Act, and is therefore limited in its domestic employment of UASs. In order to determine the applicability of UASs to homeland defense missions, it is necessary to examine the capabilities of available UASs, to match them with mission requirements, and determine the legality of where they can be used and who can operate them. A policy that places combat UAS capability with Title 10 military forces and homeland defense mission capability with Title 32 and law enforcement agencies will fulfill the goals stated in the national strategy and function within the current legal framework.

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ACKNOWLEDGMENTS

I owe a debt of gratitude to my wonderful wife Kim for her support and encouragement during this academic endeavor. My kids Gracie, Suzanne, and Jonathan have shown maturity and patience beyond their years and make me proud every day. Finally, a special thanks to my friend Joseph from Cupertino. Your assistance was invaluable.

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I. INTRODUCTION

A. EFFECTIVE USE OF UNMANNED AERIAL SYSTEMS

This thesis will argue that Unmanned Aerial Systems (UAS) are applicable to homeland defense missions, primarily in those missions that require substantial real-time information collection and exchange. Unmanned aerial systems can help governments meet increased societal demand for immediate governmental response to disaster and civil defense situations.

The U.S. military has more than five decades of experience in developing unmanned aircraft. Military support for unmanned aerial vehicles has ebbed and flowed as systems evolved, but the extensive use of UASs in Operations Iraqi and Enduring Freedom openly demonstrated the utility of these systems as battlefield tools. The range of the intelligence, surveillance, and reconnaissance capabilities of these systems stretches from tactical to the strategic level. A testament to UAS value is evident in the proliferation of military-oriented UAS procurement proposals. This intense demand threatens to ensnare even the most aggressive UAS developers in producing an unwieldy and unsustainable number of over-specialized UAS designs.

After the 9/11 attacks, the federal government published *National Strategy for Homeland Security* and the *Strategy for Homeland Defense and Civil Support.*. The former publication emphasizes that successful securing of the homeland requires a comprehensive national effort, and not just a solely federalized effort. The latter publication, published by the Department of Defense, emphasizes a layered strategy that looks beyond the capabilities of a single agency and leverages the capabilities of all levels of government. Neither document supports an exclusive use of the armed forces to defend the U.S. homeland. Instead, each document focuses on the power of a fully networked nation to use rapid information exchange in guaranteeing the defeat of an aggressor. UASs possess capabilities that can strengthen the national defense posture in this era of asymmetric warfare.

In order to facilitate a comprehensive national response to domestic incidents the Department of Defense created the United States Northern Command (NORTHCOM)

2002. NORTHCOM coordinates all types of homeland defense missions, including defense of the air, land, and maritime domains, and military support to civil agencies. One of the first obstacles NORTHCOM was forced to confront was the legal restrictions placed on the military for domestic roles. Since UASs are predominantly owned and operated by the military, legal concerns about domestic UAS utilization require similar scrutiny.

In addition to the legal and doctrinal challenges facing domestic UAS operations, the regulatory environment may constrain domestic UAS employment. Military UAS operators usually use their UAS assets in airspace solely controlled by the military. In wartime, the principle of air dominance means that the prompt removal of hostile military forces from the air domain is a priority. While maintenance of safe air operations is a paramount concern, the challenge of maintaining an orderly and safe airspace is much easier in a military controlled war zone. Civil aviation enters military-controlled airspace at its own peril. Domestic UAS operators must grapple with the challenge of guaranteeing the safe operation of unmanned aircraft in the same airspace as civil aircraft as well as the populations they overfly. In some instances permission to operate must be obtained from a foreign government if operations occur within the sovereign airspace of another country.

In order to determine the applicability of UASs to homeland defense missions, this thesis examines aerial vehicles and system capabilities, identifies broad homeland defense mission sets that could benefit from UAS capabilities, and explores the legal challenges of their use based on the user and the UASs operating environment. This thesis argues that the information sharing capabilities unmanned aerial systems have demonstrated in combat operations make UASs applicable to a wide range of homeland defense missions.

B. HISTORY OF UNMANNED AERIAL SYSTEMS AND THEIR SUCCESS

During a mission over Yemen in 2002 an unmanned aerial vehicle (UAV), under direction of the Central Intelligence Agency, identified a vehicle with Al Qaeda operatives, launched a missile and destroyed the target.[1] This was a victory in the global

1 Global Security.org, "MQ-1B Armed Predator," http://www.globalsecurity.org/intell/systems/armed-predator.htm, (accessed 27 Nov 2005).

war on terror and for the technological effort that created this new weapon system. The concept of unmanned aircraft has been pursued since the beginning of military aviation and the technology to make unmanned aircraft viable has undergone a long evolution.

UAS development began in World War I. Allied powers filled obsolete trainer aircraft with explosives and launched them toward the front lines. Success was limited and this new tactic did not contribute to the outcome of the war or even a single battle, but from these humble beginnings aviation technological advances progressed to the point where UASs now are a major component of the battle space.

"By the 1950s, focused efforts in various military projects overcame the basic problems of automatic stabilization, remote control, and autonomous navigation."[2] In fact, the pursuit of unmanned aviation "has been the driving or contributing motivation behind many of the key technical innovations in aviation: [including] the autopilot, the inertial navigation system, and data links."[3] Today, unmanned aerial systems (UAS) offer increased situational awareness of the battle space and can significantly reduce the time between threat detection and engagement compared to current intelligence collection and distribution methods.

UAS variants range from small tactical systems carried and operated by a single soldier to high altitude long endurance (HALE) systems that can operate above 60,000 feet and remain airborne for 24 hours at a time. Battlefield maturity of UASs is increasing and proving the benefits of their use. Unmanned systems have evolved to meet the so-called "dull, dirty, and dangerous" missions of the past. To describe the dull missions, the *Unmanned Aerial System Roadmap* offers an example of a long duration bombing mission. It says that, "B-2 crews flew 30-hour roundtrip missions from Missouri to Serbia during 34 days of the Kosovo conflict in 1999…Contrast this imposition on crew endurance with the nearly continuous string of day-long MQ-1 Predator missions over Afghanistan and Iraq that have been flown by stateside crews operating on a four-hour duty cycle for nearly two years."[4] During the late 1940s, the Air

2 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030,* Washington D.C.: 4 Aug 2005. p.47.

3 Ibid.

4 Ibid., p.2.

Force and Navy used unmanned B-17 bombers and F6F fighters to fly through nuclear clouds just after test detonations to collect radiation samples.[5] These drones were limited in their capability prompting the military to determine "the risk to aircrew was manageable,"[6] so subsequent missions were conducted by manned flights, exposing the crew to radioactive fallout, and clearly fitting the description as a "dirty" mission. Reconnaissance missions have always been dangerous, not only because of armed defenses, but because of the political environment. In 1960, the acceptability of manned reconnaissance flights over the Soviet Union changed overnight with the shoot down of a U-2 spy plane.

> The attributes that make the use of unmanned preferable to manned aircraft in the above three roles are, in the case of the dull, the better sustained alertness of machines over that of humans and, for the dirty and the dangerous, the lower political and human cost if the mission is lost, and greater probability that the mission will be successful. Lower downside risk and higher confidence in mission success are two strong motivators for continued expansion of unmanned aircraft systems.[7]

UAS developers have produced a bewildering array of systems with the ability to fly at high altitudes, others have an endurance measured in days, and still more are miniature stealthy vehicles that travel silently a few hundred feet above the battlefield. UASs can provide real time surveillance to increase situational awareness and they can carry communications relay equipment so command and control is not lost during times of infrastructure interruptions or environmental conditions inhibit line of sight communications. Some vehicles can carry weapons for cases where the time between target identification and its required destruction is short. The miniaturization of sensors has also provided for the ability to detect the signatures of weapons of mass destruction.

Now that UA systems have demonstrated their maturity, the potential for applicability outside the military domain is becoming an urgent priority. It is in the military's interest to rationalize UAS development and expand the UAS use at all levels of government.

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5 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030,* p.2.

6 Ibid.

7 Ibid.

C. OBJECTIVES

This thesis explores the applicability of Unmanned Aerial Systems (UAS) for Homeland Defense missions by examining their capabilities, functionality, and legal limitations. UASs are still immature, both as a weapon system and a raw platform, but their combat success is generating interest in applying these platforms to homeland defense missions within the United States.

Chapter I: "Introduction" describes the post 9/11 threat environment and the changes in defense strategy that led to the UAS to become a much more widely utilized and desirable platform. A brief history of unmanned aerial systems and their current capabilities is described, along with examples of combat success, to illustrate their capabilities for use in the United Sates. Finally, the applicability of unmanned aerial systems to homeland defense missions is outlined through a chapter summary of its five chapters.

Chapter II: "Capabilities of Unmanned Aerial Systems" describes an unclassified subset of unmanned systems and explains their capabilities. To emphasize the challenge facing homeland defense planners, the chapter contains a summary of currently available vehicles, sensor payload options and command-and-control architectures. The chapter emphasizes UAS utility. Beyond the vehicle, the available sensor suites, tailored to meet the requirements of the user, offers a daunting array of intelligence, surveillance, and reconnaissance (ISR) capabilities. Command and control system architecture offers another layer of potential capabilities. Though this chapter may at first seem focused on a tactical level, an understanding of basic UAS capabilities is critical to gain any understanding of the potential doctrinal, legal, and operational challenges to domestic UAS use.

Chapter III: "Strategy for Securing the Homeland" describes missions assigned by the *National Strategy for Homeland Security* and the *Strategy for Homeland Defense and Civil Support*. Homeland Defense mission are those missions that defend against threats in the air and space, land, and maritime domains, while Civil Support missions are those missions where military capability is provided to civil authorities during national security crises and natural or manmade disasters. This chapter examines the development and

conceptual foundations of Homeland Defense and Civil Support and identifies the transition from ad hoc and leisurely legislative branch administration of disaster response to a more timely, centralized response dominated by the executive branch. This chapter also examines the military's historical role in disaster response and civil defense.

Chapter IV: "Legal Restriction for Unmanned Aerial Systems in Homeland Defense Missions" outlines the potential restrictions and limitations on the use of unmanned aerial systems in three main areas. The first challenge is the legislation that governs domestic intelligence collection and military assistance to civil authorities. The second challenge is the fact that the military owns most of the unmanned aerial systems, but is legally inhibited from using all available assets domestically. In this regard, this chapter attempts to clarify the domestic role of federally controlled active duty military forces, (Title 10, United States Code) and explains the obligations of state controlled defense forces (regulated by Title 32, United States Code). The third challenge is the operation of unmanned vehicles in the National Airspace System. Since the majority of the missions will require a UAS to operate in the same airspace as other aircraft, performance standards and operational practices will be discussed.

Chapter V: "Applicability of Unmanned Aerial Systems" synthesizes the capabilities unmanned aerial systems offer, their functionality within the mission areas assigned for homeland defense, and the environmental and legal restriction within which they must operate. This analysis will discuss potential applications of unmanned aerial systems for homeland defense missions and suggests ways the nation could exploit UAS capabilities in a manner that fits within currently accepted legal frameworks.

Unmanned Aerial Systems offer tremendous capabilities for Intelligence, Surveillance, and Reconnaissance (ISR). They have proven successful and valuable to the battlefield warrior, but operation by more than the military will be required for the same level of success domestically. The time sensitive nature of asymmetrical threats requires an agile response force capable of situational awareness from the beginning of an attack. Sharing that information across all levels of government immediately will increase the overall ability to respond. Determining the applicability of UASs domestically will require consideration of mission capability, legal restrictions on the

agency with mission responsibility, the capability of the agency operating the UAS, and operational and constitutional legal sufficiency.

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II. CAPABILITIES OF UNMANNED AERIAL SYSTEMS

A. VEHICLES

The current definition for "UAV" is published in the Joint Publication 1-02, *Department of Defense Dictionary of Military and Associated Terms*, as "A powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or non-lethal payload. Ballistic or semi ballistic vehicles, cruise missiles, and artillery projectiles are not considered unmanned aerial vehicles."[8] This definition evolved as the capabilities of available systems increased.

When pilotless aircraft first emerged, the term drone was used. This term was employed primarily because these early aircraft were free flying and had no external input or command after launch.

As technology provided the capability to control unmanned aircraft, the term remotely piloted vehicle (RPV) became the standard and was used from the late 1940s to the late 1980s. The technical evolution continued and beginning in the late 1980s or early 1990s, as command and control ability increased, the term unmanned aerial vehicle (UAV) was adopted. Today, the term unmanned aerial system (UAS) has garnered favor because the vehicle is considered a single component of a larger weapons system.

In 2005, the Office of the Secretary of Defense published the *Unmanned Aircraft Systems Roadmap 2005-2030,* in which the Department of Defense "adopts the terminology unmanned aircraft (UA), rather than unmanned aerial vehicle (UAV), when referring to the flying component of an unmanned aircraft system…This change in terminology more clearly emphasizes that the aircraft is only one component of the system, and is in line with the Federal Aviation Administration's decision to treat "UAVs" as aircraft for regulatory purposes."[9] This will be examined in greater detail in Chapter IV, *Restrictions and Limitations.* Another significant reason to describe the

[8] Department of Defense, Joint Publication 1-02, "Department of Defense Dictionary of Military and Associated Terms," 12 April 2001, as amended through 31 August 2005, Washington D.C.. p.563. http://www.dtic.mil/doctrine/jel/doddict/ (accessed 14 March 2006).

9 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030,* p.i.

weapon system carefully is that "cruise missile *weapons* are occasionally confused with UA *weapon systems* because they are both unmanned. The key discriminators are (1) UA are equipped and intended for recovery at the end of their flight, and cruise missiles are not, and (2) munitions carried by UA are not tailored and integrated into their airframe whereas the cruise missile's warhead is."[10]

Investment in the UAS industry has burgeoned in the last ten years. Fiscal year 2003 was the first year that UAS development budgets topped the billion dollar mark.[11] A bewildering array of UA systems that range in cost from a few thousand dollars to tens of millions are currently in production. This explosion of designs makes neat categorization somewhat daunting, adding to the difficulty of matching platforms to potential mission categories that come with an array of legal and operational restraints.

UASs are generally categorized as specialized, tactical, or endurance platforms.[12] Specialized UASs are those that carry a specific, single-purpose mission payload or are designed to carry out only a single mission type. Tactical systems can carry multiple sensor packages, operate at altitudes of 5,000-25,000 feet, and have mission endurance times less than 20 hours. Broad mission applications apply within this category. Endurance systems also carry multi-sensor mission payloads but operate at altitudes up to 60,000 feet and have mission endurance capabilities of 20 hours or more.[13] Within these broad categories, vehicles and systems can be further broken down into sub categories based on size and lift mechanism. Virtually all of these systems are being considered for homeland security applications.

The smallest UA systems are classified as "micro" because of their extremely small size and light weight. They are primarily dedicated to tactical observation missions. Two examples of such vehicles are the Hornet, Figure 1 and the Wasp, Figure 2. The Wasp is seven inches long and has a wingspan of 13 inches. It is powered by an electric motor and has flown as high as 1,200 feet with a 60 minute endurance. The

10 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030,* p.1.

11 Ibid., p.37.

12 Ibid., p.39.

13 Information used for the general description of UAVs was derived from the system descriptions within the first 40 pages of the *Unmanned Aircraft Systems Roadmap 2005-2030*.

Hornet is 8 inches long and has a slightly larger wingspan of 15 inches, but the significant difference is that this is the first micro air vehicle to be powered by hydrogen. Its design incorporates the fuel cell into the shape of the wing to accommodate enough space for its tenth of a pound payload.[14]

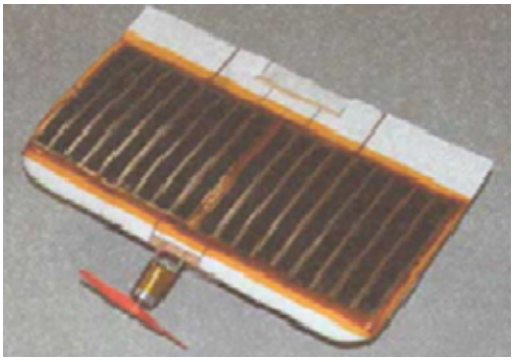

Figure 1 Hornet[15]

Figure 2 Wasp[16]

Opponents of micro vehicles might question the practicality of such a small vehicle since even the slightest wind might impair its ability to reach its observation target, but proponents advocate the advantages of their ability to operate undetected and in confined areas.

Larger, but still tiny, "miniature" vehicles offer a wider array of mission options, and more models are available in this category than in the micro category. The "Dragon

14 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.29.

15 Ibid.

16 Ibid.

Eye, Figure 3 is a 5-pound, back-packable, modular unmanned aerial vehicle designed to provide the Marine small-unit commander with an organic reconnaissance and surveillance capability to see over the next hilltop or building,"[17] and is advertised as an important integral component for deployed Marine Corps units. The Dragon Eye weighs less than five pounds, and

Figure 3 Dragon Eye[18]

has a wingspan less than four feet. This UAS can reach a maximum altitude of 1,000 feet and has a radius of 2.5 miles. It is powered by an electric motor and has a one hour maximum mission endurance.[19] Another example of a miniature vehicle is the Raven, Figure 4 operated by the Army, Air Force, and United States Special Operations Command. It also weighs less than 5 pounds and has a wingspan of just over four feet.

Figure 4 Raven[20]

17 Marine Corps Warfighting Laboratory, "Dragon Eye Improvements Factsheet," Marine Corps Warfighting Laboratory Public Affairs Office, (11 March 2005). http://www.mcwl.quantico.usmc.mil/factsheets/Dragon%20Eye%20Improvements.pdf (accessed 12 March 2006).

18 Ibid.

19 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.26.

20 Ibid., p.27.

The Raven is powered by an electric motor and has combat radius of six nautical miles. It can remain aloft for 1.5 hours and operates at altitudes up to 1,000 feet.[21] A third vehicle is the Air Force's Desert Hawk, Figure 5 which is the "UAV system's official name [for] the Force Protection Airborne Surveillance System."[22] It is a small, 7-pound remote controlled aircraft used by Air Force security forces airmen to maintain strong perimeter defenses. It is also powered by an electric motor that gives it up to an hour flight time with an operational ceiling of 1,000 feet.[23] All of the vehicles listed are made from composite material and are man-portable. Their ability to be unpacked, assembled and launched in a matter of minutes is a highly desired feature for the tactical environment.

Figure 5 Desert Hawk[24]

The next class of UAV are considered the largest ones viable for tactical operations. The first example is the MQ-5B Hunter, Figure 6 operated by the United States Army. "The RQ-5 Hunter was originally a joint Army/Navy/Marine Corps Short Range UAS that the Army intended to meet division and corps level requirements."[25] It is designed as a "robust pod-and- twin-tailboom high-wing monoplane, built of low-

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[21] Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.26.

22 Master Sergeant Don Perrien, "Air Force Desert Hawk UAV," Air Force News Service, (27 October 2003). http://usmilitary.about.com/cs/afweapons/a/afdeserthawk.htm (accessed 6 March 2006).

[23] Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.26.

[24] Ibid.

25 Ibid., p.7.

observable composites. [It has] one tractor and one pusher engine to improve single-engine survivability,"[26] and "can carry the Viper Strike and BLU 108 munitions."[27] The Hunter weighs approximately 1,800 pounds and can carry a payload of 200 pounds. It has a maximum ceiling of 18,000 feet and can loiter for up to 18 hours. It flies at just over 100 knots and

Figure 6 MQ-5 Hunter[28]

can be controlled up to 140 miles from its ground control station.[29] A second example of a tactical vehicle is the RQ-7 Shadow, Figure 7. It is a "small, stealthy shoulder-wing monoplane, with pusher engine, twin tailbooms and inverted V tail unit. Construction is mainly (90 percent) of composites (graphite and Kevlar epoxy), with optionally detachable tricycle landing gear."[30] "It weighs approximately 200 pounds and can carry a payload of 55 pounds. It operates at speeds from 61 to 144 knots at altitudes up to 15,000 feet and can loiter for up to 7 hours."[31] It is launched with a rail catapult or conventional wheeled take-off and is recovered via conventional wheel landing or with the aid of an arresting cable.[32]

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26 Jane's Unmanned Aerial Vehicles and Targets, "IAI MQ-5 and RQ-5 Hunter," (30 October 2006). http://www4.janes.com/subscribe/juav/doc_view.jsp?K2DocKey=/content1/janesdata/binder/juav/juav1298.htm@current&Prod_Name=JUAV&QueryText= (accessed 5 November 2006).

27 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.7.

28 Ibid., p.45

29 Ibid., p.7.

30 Jane's Unmanned Aerial Vehicles and Targets, "IAI MQ-5 and RQ-5 Hunter."

31 Ibid.

32 Jane's Unmanned Aerial Vehicles and Targets, "AAI RQ-7 Shadow 200," (30 October 2006). http://www4.janes.com/subscribe/juav/doc_view.jsp?K2DocKey=/content1/janesdata/binder/juav/juav1306.htm@current&Prod_Name=JUAV&QueryText= (accessed 20 November 2006).

Figure 7 RQ-7 Shadow[33]

Rotary wing vehicles are not as plentiful as the miniature vehicles but there is a strong development effort underway. The current production model purchased by the United States Navy is the called the Fire Scout, Figure 8. "The RQ-8A Fire Scout system will provide the U.S. Navy and U.S. Marine Corps reconnaissance, situational awareness and precision targeting support. The system is designed to autonomously take off from and land on any aviation-capable ship or confined land area. It will provide coverage 110 nautical miles from its launch site using a baseline payload that includes electro-optical/infrared sensors and a laser designator."[34] "The Fire Scout's dynamic system is derived [from] Schweizer's Model 333 turbine helicopter, which has been proven by over 20 million flight hours. With vehicle endurance greater than six hours, Fire Scout is capable of extended continuous operations."[35] Initial operational capability is planned for FY 2008 and service is expected with both the Navy and Marine Corps.[36]

Figure 8 Fire Scout [37]

[33] Jane's Unmanned Aerial Vehicles and Targets, "AAI RQ-7 200."

[34] Global Security.org, "RQ-8A Fire Scout Vertical Take Off and Landing Tactical Unmanned Aerial Vehicle (VTUAV)," http://www.globalsecurity.org/intell/systems/vtuav.htm (accessed 12 March 2006).

[35] Ibid.

[36] Ibid.

37 US Navy News, "Autonomous Fire Scout UAV Lands on Ship," Naval Air Systems Command Public Affairs, (24 January 2006). http://www.news.navy.mil/search/display.asp?story_id=22038 (accessed 25 October 2006).

A variation on the rotary wing category is the tilt rotor aircraft called the Eagle Eye, Figure 9. "The Bell Eagle Eye has the appearance of a conventional aircraft with tilt rotors at the end of each wing that allow it to maneuver up or down and hover. Bell Helicopter Textron Incorporation (BHTI) became involved with the Unmanned Aerial Vehicle (UAV) program by taking the wind tunnel V-22 model, using off the shelf helicopter parts, i.e., engine, drive shafts, gear boxes, etc. and built the Eagle Eye tilt rotor UAV."[38] "The Eagle Eye has a wing span of 15.2 ft, is 17.9 ft in length, is 5.7 ft high, and weighs around 2,000 pounds (depending on payload)."[39] "The United States Coast Guard intends to purchase 69 systems for deployment on their National Security Cutter and legacy Deep Water Cutters."[40]

Figure 9 Eagle Eye[41]

A category of systems outside the conventional fixed and rotary wing classes are tethered balloons called aerostats. Aerostats are not new. A system called the Tethered Aerial Radar System (TARS), Figure 10 has been operated by the military and the United States Customs and Border Protection service. "The current aerostat network consists of two sizes of aerostats (275,000 cubic feet and 420,000 cubic feet) and two varieties of radars. The average aerostat is about two times the size of the Goodyear Blimp, i.e., the 420,000 cubic foot, aerodynamically shaped balloon measures 208 feet long by 65 feet

38 John Pike, FAS Intelligence Resource Program, "Eagle Eye UAV," (27 November 1999). http://www.fas.org/irp/program/collect/eagle-eye.htm (accessed 12 March 2006).

39 Ibid.

40Department of Homeland Security, US Coast Guard, "Bell Helicopter Awarded Contract for Eagle Eye UAV," http://www.uscg.mil/deepwater/media/bell.htm (accessed 11 March 2006).

41 John Pike, "Eagle Eye UAV." (27 November 1999).

across the hull, with a tip-to-tip tail span of 100 feet."[42] "The aerostat consists of four major parts or assemblies: the hull, the windscreen and radar platform, the airborne power generator, and the rigging and tether assembly."[43] The two chamber hull is made of a polyurethane-coated fabric that weighs less than 8 ounces per yard. The upper chamber is larger and contains the helium that lifts the aerostat. The lower section, called the ballonet, is pressurized and maintains the shape of the aerostat through pressure changes associated with altitude. The windscreen compartment is also pressurized and contains the radar. The rigging contains the mooring suspension lines and the suspension lines which can lift the aerostat up to 15,000 feet.[44]

Figure 10 Tethered Airborne Radar System[45]

Figure 11 Joint Land Attack Elevated Netted System[46]

42 Department of the Air Force,"Tethered Aerostat Radar System," Air Combat Command Public Affairs Office, (January 2003). http://www.acc.af.mil/library/factsheets/factsheet_print.asp?fsID=2359&page=1 (accessed 11 March 2006).

43 Ibid.

44 Ibid.

45 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.33.

46 Ibid.

The Joint Land Attack Netted Aerial Sensor (JLENS), Figure 11 is slightly larger than the TARS. It is 233 feet long and its envelope is 590,000 cubic feet. This extra capacity

boosts its payload to 5,000 pounds.[47] "A JLENS system consists of two aerostats, one containing a surveillance radar (SuR) and one containing a precision track illumination radar (PTIR). Each aerostat is tethered to a mobile mooring station and attached to a processing station via a fiber optic/power tether."[48] The JLENS operates at 10 to 15 thousand feet and can keep its radar sensors aloft for a period up to 30 days.[49] A final example of the aerostat is one used in Operation Enduring Freedom called the Rapidly Elevated Aerostat Platform (REAP).

Figure 12 Rapidly Elevated Aerostat Platform[50]

"This 31-feet long aerostat is much smaller than the TARS, and operates at only 300 feet above the battlefield. It is designed for rapid deployment (approximately 5 minutes) from the back of a HMMWV and carries daytime and night vision cameras."[51] It has the capability to lift a 35 pound payload and maintain its altitude for up to 10 days.[52]

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[47] Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.33.

[48] Ibid.

[49] Ibid.

[50] Ibid., p.34.

[51] Ibid.

[52] Ibid.

Aerostats by definition are tethered and are somewhat vulnerable in contrast to the next category of vehicles, airships, which are controllable and can be repositioned as mission needs dictate.

Airships are not currently operational in defense missions but development of their capabilities is underway. One of the critical components of intelligence, surveillance, and reconnaissance is persistence. Typical powered aircraft are unable to provide the loiter time needed for plausible persistence, whereas airships have the potential to measure their time aloft in weeks or even months. These vehicles can vary in size depending on the type of mission they are designed to perform. Payload weight is not a limiting factor because large airship designs are necessary to reach and maintain altitudes above 65,000 feet where weather, the jet stream, and other air traffic are absent. The niche between unmanned vehicles and satellites is the mission area that airships could potentially fill.

A final special mission vehicle worth noting is the parafoil. Two examples are the SnowGoose, Figure 13 and Onyx, Figure 14 used by the United States Special Operations Command.

Figure 13 SnowGoose[53]

> The SnowGoose is a powered, programmable, GPS guided parafoil with modular payload bays that can carry up to six individual payload or fuel bins. [It] can be ground launched from a HMMWV or air-deployed from a C-130, C-141, or C-17 at altitudes up to 25,000 feet. From the ground, it

[53] Andreas Parsch, "Directory of U.S. Military Rockets and Missiles: Appendix 2: Modern UAVs," (26 August 2005). http://www.designation-systems.net/dusrm/app2/q-10.html (accessed 8 November 2006).

can climb to 18,000 feet. It can carry up to 575 pounds of leaflets, supplies, or other fixed cargo payloads with an endurance of 1-3 hours or it can stay aloft with a 75 pound payload for 14-16 hours. (Note: Endurance is a function of the selection of ground launch or air launch parachute kit, with greater endurance achieved in its ground launch configuration). The SnowGoose is designed to operate with only four [ground crew] with a turn-around time of less than four hours between uses.[54]

Figure 14 Onyx[55]

The Onyx is an autonomously guided parafoil system that, in contrast to the SnowGoose, is not powered. "Onyx systems are air-deployed from C-130, C-141, or C-17 at up to 35,000 ft., and autonomously glide over 30 miles and land cargo within 150 ft. of a target. Cargo for ground and special operations forces includes food and water, medical supplies, fuel, munitions and other critical battlefield payloads. Onyx includes advanced capabilities such as flocking (formation flying), active collision avoidance, and adaptive control (self-learning functions). With this technology, multiple systems (50+) can be deployed in the same airspace, guiding payloads to one, or multiple targets without possibility of midair collisions. Smaller versions have been developed to precisely deliver sensors or submunitions.[56]

Arguably the most well known unmanned vehicle is the Predator. It began as the RQ-1 and was intended as a tactical, medium altitude, long endurance unmanned vehicle. This version is powered by an internal combustion, 101 horsepower Rotax engine and has a maximum takeoff weight of 2,250 pounds. It cruises between 84 and 135 miles per hour and has an operating range up to 400 nautical miles at altitudes as high as 25,000

54 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030,* p.24.

55 Ibid., p.25.

56 Ibid.·

feet.[57] Its loiter time was dependent on vehicle configuration but could reach 24 hours. The evolutionary process produced a turbine powered variant called the MQ-9 Predator B, Figure 15 which was subsequently renamed the Reaper in September 2006,[58] with capabilities more closely aligned with strategic UASs. The MQ-9 is significantly more capable than the RQ-1 based primarily on its turboprop powerplant and slightly larger size. It is 18 feet longer and has a wingspan 9 feet more than the RQ-1 which gives this vehicle an ability to carry an 800 pound internal payload and 3000 pound external payload. Its enhanced performance of 220 knots maximum speed, a loiter capability of up to 30 hours, and a maximum altitude of 50,000 feet qualifies it as medium to high altitude, long endurance system.[59] The latest variant of the Predator is called the Mariner and was designed specifically with homeland security border and maritime defense mission in mind. The wingspan increased by 20 feet over the MQ-9 to a total of 86 feet but the payload capacity was reduced to 1,150 pounds internally and 2,000 externally for a total of 3,150 pounds. The decrease in payload weight and longer wing combines to produce a maximum airspeed of 240 knots, a ceiling of 52,000 feet and a loiter time of up to 49 hours.[60]

Figure 15 Mariner Variant of Predator[61]

57 Department of the Air Force, "MQ-1 Predator Unmanned Aerial Vehicle," Air Combat Command Public Affairs Office, (October 2005). http://www.af.mil/factsheets/factsheet_print.asp?fsID=122&page=1 (accessed 12 March 2006).

58 Air Force Link, "Reaper' Moniker Given to MQ-9 Unmanned Aerial Vehicle," (14 September 2006). http://www.af.mil/news/story.asp?storyID=123027012 (accessed 20 November 2006).

59 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.10.

60 General Atomics Aeronautical Systems, "Mariner," (November 2006). http://www.ga-asi.com/products/mariner.php (accessed 5 November 2006).

61 Military.com, "BORDERLINE: Unmanned Aerial Vehicles for Homeland Security," http://www.military.com/soldiertech/0,14632,Soldiertech_HomelandUAV,,00.html (accessed 8 November 2006).

The MQ-4 Global Hawk, Figure 16 is the largest and heaviest vehicle in the high altitude long-endurance (HALE) category as of this writing. "Global Hawk, which has a wing- span of 116 feet (35.3 meters) and is 44 feet (13.4 meters) long, can range as far as

Figure 16 MQ-4 Global Hawk[62]

12,000 nautical miles, at altitudes up to 65,000 feet (19,812 meters), flying at speeds approaching 340 knots (about 400 mph) for as long as 35 hours. During a typical mission, the aircraft can fly 1,200 miles to an area of interest and remain on station for 24 hours."63 Modifications to this vehicle are underway and subsequent production aircraft will have a slightly longer wing, a more powerful engine, and an increased payload capacity of just over 1,000 pounds. The trade-off is a 5,000 foot lower ceiling, a 30 knot decrease in loiter speed, and a 4 hour reduction in endurance.[64]

These vehicles are designed for endurance and altitude and serve the purpose of getting the ISR sensors into their optimal position for persistent surveillance. As impressive as they are, the reality is that they are nothing more than the transport platform for the mission payload.

B. PAYLOAD

The UAS Roadmap says "payloads currently in use or envisioned for use on [unmanned aircraft] (UA) fall into the four general categories of sensors (electro-optical,

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62 Department of the Air Force, "Global Hawk," Aeronautical Systems Center Office of Public Affairs Office, (October 2005).http://www.af.mil/factsheets/factsheet.asp?fsID=175&page=2 (accessed 8 November 2006).

63 Ibid.

64 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.6.

radar, signals, meteorological, chem-bio), relay (communications, navigation signals), weapons, and cargo (leaflets, supplies), or combinations of these. The desire for endurance in many UA demands a high fuel fraction, resulting in a corresponding low payload fraction, typically 10 to 20 percent of gross weight."[65] As a result, the miniaturization of sensors is ongoing in order to increase the loiter times of current vehicles. The mission applications for domestic homeland defense are different from those in the traditional combat environment where "find, fix, and finish" is accomplished by an armed UAS. Domestic UAS use will only include the find and fix elements of the combat environment, leaving the "finish" element to the most appropriate agency. As a result, this thesis will focus on ISR sensors and communication relay packages as those most likely for homeland defense missions.

"The dominant requirement for sensing is for imaging (visible, infrared, and radar), followed by signals (for the SIGINT and SEAD missions), chemical (WMD), biological (WMD), radiological (WMD), meteorological (METOC), and magnetic (anti-submarine warfare (ASW) and [mine countermeasures] MCM)."[66] The advanced sensors we have today (visible, infrared, and radar) stem from battlefield rules of engagement for positive identification before engagement.[67] More simply stated we needed to be sure that what we were looking at was in fact what we wanted to destroy. Seeing the target is accomplished via multiple sensors.

Electro-optical (EO) systems are sensors that use cameras to collect imagery. Cameras began as wet film cameras that required the processing of its film after completing the reconnaissance mission. Wet Film cameras were made increasingly smaller over time, but technology has progressed to the digital realm instead of film. Still images are still useful, but the ability to collect digital video imagery, Figure 17 also exists and produces the added benefit of being able to track moving targets. Commercial technology has miniaturized video cameras to acceptable size and weight measurements

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[65] Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.56.

[66] Ibid., p.58.

[67] Ibid.

for unmanned aircraft and their presence is found on almost all of the sensor packages installed. In addition to daytime video, current camera systems can detect images in low

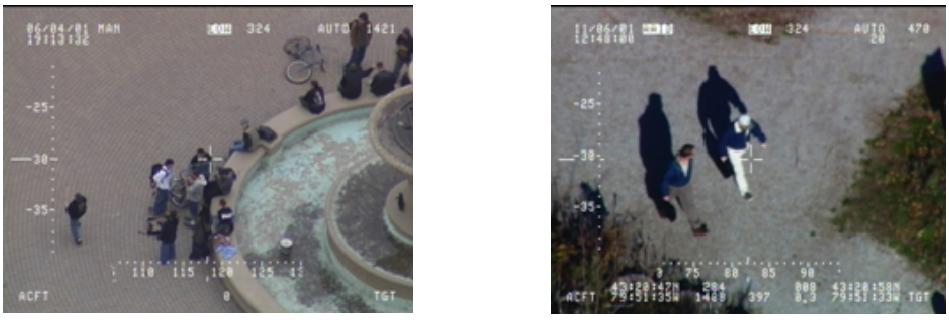

Figure 17 Video Imagery[68]

light conditions, but their effectiveness is limited as light levels diminish. To maintain the ability to see under low and no light conditions, sensor packages often pair electro optical cameras with infrared cameras.

> Infrared light lies between the visible and microwave portions of the electromagnetic spectrum. Infrared light has a range of wavelengths, just like visible light has wavelengths that range from red light to violet. "Near infrared" light is closest in wavelength to visible light and "far infrared" is closer to the microwave region of the electromagnetic spectrum. The longer, far infrared wavelengths are about the size of a pin head and the shorter, near infrared ones are the size of cells, or are microscopic.[69]

Infrared cameras detect these emissions and assign colors to different temperature ranges, creating an image, Figure 18 that the human eye can interpret. Visible light levels do not affect their ability to operate.

[68] LCDR Troy Beshears, *DHS Unmanned Aerial Vehicle Brief*, slide 10.

69 National Aeronautics and Space Administration, "The Infrared," http://imagers.gsfc.nasa.gov/ems/infrared.html (accessed 12 March 2006).

Figure 18 Infrared Imagery[70]

Synthetic Aperture Radar (SAR) is the next step when low light levels prevent the use of electro optical cameras and visibility levels prevent the use of infrared sensors. "SAR is a sophisticated all-weather sensor capable of providing photographic-like images through clouds, in rain or fog and in day or night conditions."[71]

> Compared to real aperture radar, synthetic aperture radar synthetically increases the antenna's size or aperture to increase the image resolution. As the platform carrying the radar moves, a pulse is transmitted at multiple positions. The return echoes pass through the receiver and are recorded in an "echo store." Because the radar is moving relative to the ground, the returned echoes are Doppler-shifted (negatively as the radar approaches a target, positively as it moves away). Comparing the Doppler-shifted frequencies to a reference frequency allows many returned signals to be focused on a single point, effectively increasing the length of the antenna that is imaging that particular point.[72]

The Sandia National Laboratory in collaboration with the General Atomics Corporation has created a SAR for the Predator called the Lynx which has the capability to execute the onboard processing just described. "Flying at an altitude of 25,000 feet, the Lynx SAR can produce one-foot resolution imagery at standoff distances of up to 55 kilometers. At a resolution of four inches, the radar can make images of scenes which are 25 kilometers away (about 16 miles) even through clouds and light rain."[73] As mentioned earlier, high resolution video was an advantage over still images because it

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[70] LCDR Troy Beshears, *DHS Unmanned Aerial Vehicle Brief*, slide 10.

71 U.S. Department of Energy, Sandia National Laboratories, Sandia National Labs News Release, "Sandia, General Atomics Unveil New Fine Resolution Synthetic-Aperture Radar System," (28 August 1999). http://www.sandia.gov/media/NewsRel/NR1999/Lynx.htm (accessed 9 March 2006).

72 Mercury Computer Systems Inc., "Synthetic Aperture Radar," http://www.mc.com/industries/aero/radar/sar.cfm (accessed 13 March 2006).

73 Sandia National Labs News Release, "Sandia, General Atomics Unveil New Fine Resolution Synthetic-Aperture Radar System."

provided the ability to track moving targets. The presence of visibility restrictions does not take away that capability because of the SAR. "A Ground moving target indicator (GMTI) system uses the Doppler shift in frequency in the returned ("bouncing") signal to distinguish moving ground vehicles from their stationary surroundings."[74]

Figure 19 Visual Image[75]

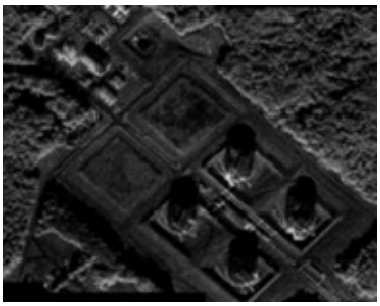

Figure 20 SAR Image[76]

Multi spectral imagery (MSI) and hyper spectral imagery (HIS) are an additional capability now available on unmanned aircraft. This technology has historically been more closely associated with satellites and mapping functions, but technical evolution has made them possible for unmanned aircraft. "Remote sensing was used by the military in World War II, Korea and Vietnam for tactical and strategic reconnaissance and surveillance. MSI is a direct out-growth of the operational success of Color Infrared

74 Mercury Computer Systems Inc., "Synthetic Aperture Radar," http://www.mc.com/industries/aero/radar/sar.cfm (accessed 13 March 2006).

75 LCDR Troy Beshears, *DHS Unmanned Aerial Vehicle Brief,* slide 10.

76 Ibid.

(CIR) imagery of the 1960's." [77] The success of CIR prompted researchers to examine ways to exploit a broader range of the electromagnetic spectrum and "today, MSI covers the portion of the electromagnetic spectrum from the ultraviolet region through the infrared region."[78] "The ability to record spectral reflectances in different portions of the electromagnetic spectrum is the main attribute of MSI, which can be useful in a number of applications."[79] Operation Desert Storm used MSI for terrain analysis, high resolution map imagery, three dimensional topography models for mission planning, tracking Scud missile activity, and imagery maps of enemy positions. "Hyper spectral imaging is similar to MSI but with data collected in hundreds of spectral bands. The increased number of sensor bands provides higher spectral resolution and more opportunities to detect subtle spectral differences in signatures that are too narrow to be differentiated on MSI."[80] This imagery capability expands analysis possibilities of the electromagnetic spectrum and complements electro-optical and infrared capabilities. Seeing your target is important, but so is communicating what you see and unmanned aircraft offer that capability as well.

In instances where communications have been hampered, a 1997 study of UAVs as communications platforms concluded that "tactical communication needs can be met much more responsively and effectively with airborne communication nodes than with satellites."[81] The Defense Advanced Research Project Agency is developing "a modular, scalable communication relay payload that can be tailored to fly on a RQ-4/Global Hawk and provide theater-wide support (300 nm diameter area of coverage) or on a RQ-7/Shadow for tactical use (60 nm diameter area)."[82] This capability is crucial for soldiers on the battlefield where no communications infrastructure exists or terrain makes line of sight communications unreliable. The same applicability also exists domestically when

77 Department of the Air Force, Air University, "Air University Space Primer," August 2003. p.12-1. http://space.au.af.mil/primer/multispectral_imagery.pdf (accessed 12 March 2006).

78 Ibid., p.12-2.

79 Ibid., p.12-1.

80 Ibid., p.12-14.

81 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.61.

82 Ibid.

recovering from natural disasters or terrorist attacks render cell phone relay towers and the landline infrastructure unreliable or inoperative.

A combination of sensors is usually the desired payload. Mission requirements can dictate that only certain sensors be sent aloft but industry is producing combined sensor packages. This contributes to the flexibility in tasking or redirecting missions already underway. As an example of a sensor package for the Predator: "The surveillance and reconnaissance payload capacity is 450lb and the vehicle carries electro-optical and infrared cameras and a synthetic aperture radar…two-color DLTV television…high resolution FLIR…[and a] Multi-Spectral Targeting System (MTS-A)."[83] "Other payload options, which can be selected to meet mission requirements, include a laser designator and rangefinder, electronic support and countermeasures and a Moving Target Indicator (MTI)."[84] Maximum mission flexibility is gained when UASs are tightly controlled while retaining the ability to work slow, dirty, long missions, is still able to respond to swiftly changing situations. Again, all of these sensor packages have potential utility in homeland security activities. However, maximum mission flexibility is enabled by a robust command and control capability. As a result, the next section will examine UAS command and control capabilities.

C. COMMAND AND CONTROL

Command and control of unmanned aircraft is made up of two basic categories. The first category addresses the control of the aircraft itself. Simple commands to climb, turn, and change speed are required for all phases of flight. The second category is the control or operation of the onboard sensors for mission requirements. The most simple example of command and control would be miniature vehicles. These are typically used for over-the-hill tactical reconnaissance by ground soldiers who need to see what they are about to engage. The vehicles are small and only have a basic video camera that "sees" what is below and slightly in front of its flight path. In other words, you fly the camera over what you want to see versus panning the camera while on a constant flight path. Control of these types of vehicles is accomplished by a basic remote control or laptop

83 SPG Media Limited, "Predator RQ-1/MQ-1/MQ-9 Unmanned Aerial Vehicle (UAV), USA," (2006). http://www.airforce-technology.com/projects/predator/ (accessed 14 March 2006).

84 Ibid.

computer. In slightly more sophisticated systems like the Dragon Eye, routes can be programmed on a laptop and loaded into the onboard navigation system via the ground control station modem. Once the Dragon Eye is launched it will navigate via global positioning system waypoints on its own. If routing changes are required while it is airborne, the new route can be sent via the ground control station modem. The video images are sent back via line of sight radio frequency and have a range of approximately 10 kilometers.[85] This arrangement is an example of a closed circuit system since operation is limited to the ground control station and the vehicle only.

More complex systems like that of the Predator have a more robust architecture.

> The Predator system consists of the aircraft, a Ground Control Station (GCS), and a Launch and Recovery Element (LRE). The GCS consists of flight control equipment, sensor control equipment, LOS data link, VHF/UHF radio and Ku SATCOM data link. The LRE contains a subset of the GCS equipment, the minimum required for launch and recovery. Predator pilots manipulate aircraft flight controls in real time using the LOS data link to accomplish takeoffs and landings. Once airborne, the pilot couples the autopilot to the navigation system, and the aircraft navigates to selected waypoints. The Predator LRE has no [beyond line of sight] communications, so it must maintain LOS until it transfers control to the GCS. The pilot in the GCS controls the Predator remotely via Ku-band SATCOM and receives the sensor products via the same link.[86]

During OEF, the Predator system prosecuted the Global War on Terrorism from a fully operational deployed GCS, Figure 21. Remote split operations (RSO) (geographically separated GCS control of the Predator) enhanced Predator capability in the OEF area of responsibility and enabled the launch of an additional aircraft to support simultaneous or high priority operations. A key element of RSO was the intensive use of secure internet "chat." Chat was initially established between two geographically separated GCSs to improve secure communication connectivity. Chat rooms were subsequently established as a means of communications between the tasking authority, command and control units, and flight crew. Another version of RSO "employs a smaller version of the GCS called the Launch and Recovery GCS. The LRGCS conducts

85 Marine Corps Warfighting Laboratory, "Dragon Eye Improvements Factsheet."

86 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.C-2.

takeoff and landing operations at the forward deployed location while the CONUS based GCS conducts the mission via extended communications links."[87]

Operation Iraqi Freedom (OIF) also saw extensive remote split operations. "The Predator LRE operated from two forward operating locations, and demonstrated flexible flying operations that included an aircraft "divert" and aircraft intra-theater deployment capability using the two LREs. The Predator system demonstrated "surge" operations by simultaneously controlling four airborne Predators for seven days, [but] most importantly, the Predator successfully operated across the entire spectrum of the find, fix, track, target, engage, and assess (F2T2EA) kill chain."[88]

The distribution of the images collected by the Predator is accomplished "through a line of sight data link or via over the horizon Ku-band satellite link to the Predator Primary Satellite Link (PPSL). Video feeds are then piped out to the DCGS [distributed common ground system] and the Air Operations Center (AOC) through theater communications or the Defense Information Services Network (DISN). Video is also broadcast to a virtually unlimited number of users through the Global Broadcast Service (GBS) via the GBS inject facility."[89]

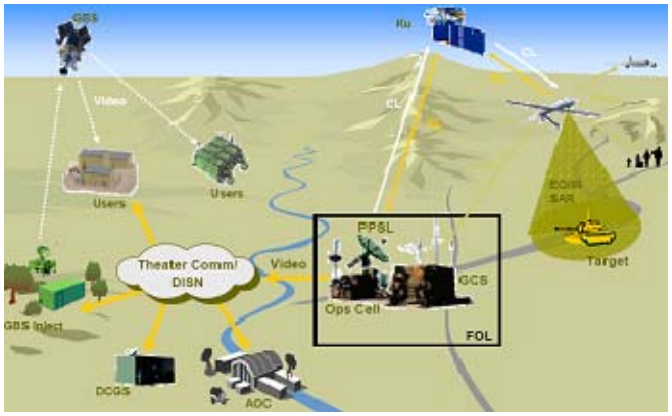

Figure 21 Predator Operating in Deployed Mode[90]

87 Department of the Air Force, "MQ-1 Predator Unmanned Aerial Vehicle."

88 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.C-3. (The surge capability described is noteworthy since the primary crew for the predator system is one pilot and two sensor operators.)

89 Ibid., p.C-4.

90 Ibid.

The Global Hawk also has a complex command and control architecture. Its capabilities resemble that of the Predator's but imagery is collected and disseminated via the mission control element at Beale AFB, California. During OEF the communications architecture resembled that of the Predator in that the mission control element was forward deployed and all facets of information control were processed forward. "Operators used the experience gained from Global Hawk activities in OEF to streamline operations during OIF. Again, the LRE launched the aircraft from a forward operating location; however, all operations were performed using reach-back to the MCE located in the CONUS, not forward deployed."[91] Global Hawk was able to fly both preplanned and ad hoc missions in theater because of the robust communications architecture between the mission control element, the combined air operations center and the intelligence analysts.[92]

> 'Secure Chat' via Secret Internet Protocol Router Network (SIPRNET) was established between the Global Hawk pilot/sensor operator, the Global Hawk liaison officer at the CAOC, and the Intelligence Mission Operations Commander at the exploitation center. This provided situational awareness and enabled command of the mission in response to ongoing operations and other emerging requirements.[93]

The range of complexity of command and control architectures is important to explore because the DoD is moving toward network centric operations. While the smallest tactical unmanned aircraft may not require more than its simple closed circuit system, larger strategic systems can be more effective if they operate on a network structure. At present, information exchanges for large UASs like Predator, Reaper, and Global hawk "occur primarily between the UA, its control station, and specially designed external interfaces, such as Air Traffic Control voice radio and video feeds. UA products, after being processed, flow to external nodes from the control station servers through network connections."[94] This, in effect, means that the UAS control station is "an edge device on the [global information grid] GIG [that] provides information to the

91 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, p.C-2.

92 Ibid.

93 Ibid.

94 Ibid., p.C-7.

user community, while keeping the UA isolated from the GIG." [95] "The first step to achieving net-centricity involves net enabling the interfaces. This means creating IP based network connections and routers between UA subsystems and the on board data link with corresponding network interfaces between the control station data link, control station subsystems, and the GIG." [96] "Functions and products of UA implemented as network nodes would be accessible to other authorized nodes on the GIG, not just to the control station [and] the UA itself becomes an edge device on the GIG, [Figure 22]."[97]

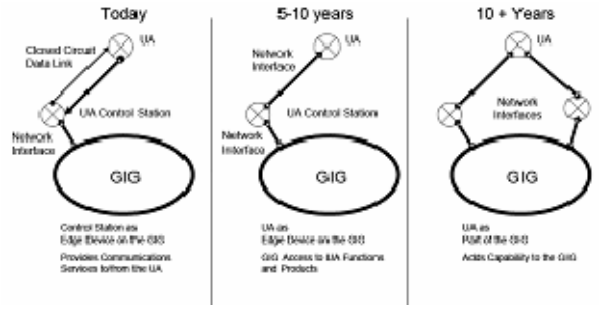

Figure 22 UA progression from circuit based to net-centric communications[98]

Future success of unmanned aircraft will rely on their ability to provide situational awareness to those who need the sensor data collected. The battlefield soldier, military commanders, border patrol agents, United States Coast Guard, and law enforcement officials could all benefit from real time access to this information. As these systems mature, the focus will shift from the operator/consumer paradigm to the assumption of UA operation for multiple consumers across the federal government.

95 Office of the Secretary of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030,* p.C-7.

96 Ibid.

97 Ibid.

98 Ibid., p.C-6.

III. STRATEGY FOR SECURING THE HOMELAND

A. HOMELAND DEFENSE EVOLUTION SINCE WORLD WAR II

The present day organizational structure and responsibility for providing homeland security is the product of an evolutionary process. The pursuit of "the most economical, efficient, and effective arrangements for protecting the nation" [99] began well before the Declaration of Independence and will continue indefinitely.

Until 1950, the federal government was intermittently involved in disaster relief. "Occasionally, Congress would pass special relief measures to help people, as well as state and local governments, recover from certain serious disasters."[100] Examples of such legislation include: the "Act of January 24, 1827 (6 stat. 356, ch. 3): Appropriations of $20,000 for relief of fire sufferers of Alexandria D.C. (now Virginia),"[101] The "Act of April 23, 1875 (18 Stat. 34, ch. 125): Issue of food and Army clothing to sufferers from overflow of lower Mississippi River; no amount specified,"[102] and the "Act of May 18, 1898 (30 Stat. 419, ch. 345) : Issue of subsistence, medical, and quartermaster's supplies etc. to destitute inhabitants of Cuba. No amount specified."[103] Congress provided specific legislation for disaster relief a total of 122 times between 1803 and 1944.[104] Often this occurred with little involvement or policy guidance from the president.[105] In general, the department or agency most suited to provide relief was tasked and, more than not, the military was the most capable agency for providing local relief. This policy

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99 Henry B. Hogue and Keith Bea, *Federal Emergency Management and Homeland Security Organization: Historical Developments and Legislative Options*, Washington D.C.: Congressional Research Service Report for Congress, 1 August 2006. Library of Congress Congressional Research Service, Order Code RS33369. p.2.

100 Richard T. Sylves, "U.S. Disaster Policy and Management in an Era of Homeland Security," Federal Emergency Management Agency. p.5. http://training.fema.gov/EMIWeb/edu/docs/EMT/Chapter%20%20Disaster%20Policy%20and%20Management%20in%20an%20Era%20of%20HS.doc (accessed 15 Oct 2006.).

101 U.S. Congress. Congressional Record. 81st Cong., 2d sess., 1950 Vol. 96, pt. 9. Congressional Record. 1950. Washington, DC., p.11900.

102Ibid.

103 Ibid., p.11900.

104 Ibid., pp.11900-11902.

105 Sylves, "U.S. Disaster Policy and Management in an Era of Homeland Security," Federal Emergency Management Agency," p.5.

practice, although leisurely and ad hoc, ensured that some relief was eventually provided to those affected by a disaster. This policy of disaster response was practiced until the Cold War, when efforts to secure the U.S. homeland began to force a shift toward defense and vulnerability mitigation. Since the federal agencies capable of responding to military aggression were also the ones that had historically provided disaster relief, combining these functions seemed logical.[106]

During World War II civil defense was widely considered to be a state responsibility but immediately following the war federal organizations began to evolve in response to war-related concerns. "These included the following:

- Continuity of government,
- adequacy of critical resources and capacities such as food, medicine, communications, and transportation;
- industrial mobilization for military response needs in time of war or national security emergency, and
- civil defense--localized emergency protective and response measures in the event of an attack."[107]

The government's capabilities to respond to defense requirements were sometimes distinct, but also overlapped the requirements to meet disaster relief requirements.[108]

The first comprehensive effort to mitigate government shortcomings in disaster relief legislation was the Disaster Relief Act of 1950. It authorized all federal agencies to provide assistance to states and localities once the President determined that relief requirements had exceeded a state's capabilities. In the event of such a disaster, the federal government then would provide "equipment, supplies, facilities, personnel, and other resources,"[109] as required.

In order to effectively provide federal government relief, an office to coordinate such efforts was required. In March 1951, President Truman delegated emergency

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[106] Henry B. Hogue and Keith Bea, *Federal Emergency Management and Homeland Security Organization: Historical Developments and Legislative Options,* p.5.

[107] Ibid., p.6.

108 Ibid.

109 Ibid., p.5.

management authority to the Housing and Home Finance Administrator.[110] This arrangement lasted until 1953 when Truman turned this authority over to the Federal Civil Defense Administration.[111] The responsibility to provide disaster relief and civil defense functions was moved or distributed to several agencies between 1950 and 2006 and is outlined in Tables 1-5. In 1969, President Nixon signed the Disaster Relief Act of 1969 and vested most of the authority under this act in the Office of Emergency Preparedness (OEP). As a result, "the gap between civil defense and natural disasters narrowed."[112] The OEP had considerable authority but political pressures eventually resulted in the decentralizing of its powers. To avoid such pressure in the future, President Nixon retained all authority within the office of the President and distributed responsibility for response activity. He charged the Department of Housing and Urban Development with preparedness for and relief of civil emergencies and disasters, the General Services Administration was given responsibility for continuity of government, Treasury was charged with investigating imports that might threaten national security, and civil defense was once again placed in the Department of Defense.[113]

According to a 1977 study conducted by the National Governor's Association,[114] the redistributed responsibilities fragmented civil defense capabilities within the federal government and slowed the overall federal response to disasters. As a result of this study President Carter submitted a reorganization plan to Congress that was quickly approved. On March 31, 1979, President Carter issued an executive order establishing the Federal Emergency Management Agency (FEMA) as an independent agency. One of the more significant responsibilities given to FEMA was the authority to coordinate "all civil defense and civil emergency planning, management, mitigation, and assistance functions," and "preparedness and planning to reduce the consequences of major terrorist incidents."[115]

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[110] Henry B. Hogue and Keith Bea, *Federal Emergency Management and Homeland Security Organization: Historical Developments and Legislative Options,* p.5.

[111] Ibid., p.6.

[112] Ibid., p.11.

[113] Ibid., pp.12-13.

114 Ibid., p.13.

[115] Ibid., p.14.

FEMA continued to mature as an organization even while suffering wide criticism after bungled and untimely responses to Hurricane Hugo in 1988 and the Loma Prieta earthquake in 1989. However, a 1991 GAO study determined that "FEMA generally fulfilled its statutory obligations to supplement state and local efforts."[116] The same GAO report also concluded that FEMA was "not prepared to take over the state's role as [an] immediate responder."[117] This judgment became evident during the aftermath of Hurricane Andrew in 1993. "In an attempt to address the deficient response, President H.W. Bush bypassed FEMA and sent in a task force led by Secretary of Transportation Andrew H. Card, Jr., to coordinate the response."[118]

In September, 1992 Congress directed FEMA to commission the National Academy of Public Administration (NAPA) to study the federal, state, and local governments' capacities to respond to major natural disasters. The study identified organizational improvements within FEMA and the reduction of the number of congressional committees that oversee it.[119] Overall, it concluded that FEMA "or its successor would need a more coherent legislative charter, greater funding flexibility, and sustained support for building an effective agency and a national emergency management system."[120]

Dr. James Lee Witt became director of FEMA in April 1993 and reorganized the agency and adopted many of the suggestion from the NAPA report. A significant milestone in the agency's history occurred in 1996 when President Clinton extended Cabinet membership to FEMA and Dr. Witt.[121] "When forming his cabinet in 2001,

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116 General Accounting Office, *Disaster Assistance: Federal, State, and Local Responses to Natural Disasters Need Improvement,*. (Washington, D.C.: U.S. General Accounting Office, 6 August 1991). Order No. RCED-91-43. p.66.

117 General Accounting Office, *Disaster Assistance: Federal, State, and Local Responses to Natural Disasters Need Improvement,* p.66

118 Henry B. Hogue and Keith Bea, *Federal Emergency Management and Homeland Security Organization: Historical Developments and Legislative Options,* p.15.

119 Ibid., p.16.

120 National Academy of public Administration, *Coping with Catastrophe: Building an Emergency Management System to Meet People's Needs in Natural and Manmade Disasters,* (Washington: February 1993). pp. xii-xiii.

121 Henry B. Hogue and Keith Bea, *Federal Emergency Management and Homeland Security Organization: Historical Developments and Legislative Options,* p.18.

President George W. Bush elected not to include the FEMA Director among its members."[122]

Year	Authority	Organizational Development
1947	National Security Act of 1947 (61 Stat. 499).	National Security Resources Board (NSRB) is established.
1949	Reorganization Plan No. 4 of 1949.	NSRB is transferred to the Executive Office of the President (EOP).
1950	Defense Production Act of 1950 (64 Stat. 798), followed by E.O. 10193 (*Federal Register*, vol. 15, Dec. 19, 1950, p. 9031).	The Office of Defense Mobilization (ODM) is established in the EOP.
1950-1951	Disaster Relief Act of 1950 (64 Stat. 1109), followed by E.O. 10221 (*Federal Register*, vol. 16, Mar. 6, 1951, p. 2051).	The act is the first comprehensive federal disaster relief law, and it delegates certain emergency management authorities to the President. These authorities are delegated to the Housing and Home Finance Administrator.
1950	E.O. 10186 (*Federal Register*, vol. 15, Dec. 5, 1950, p. 8557).	The Federal Civil Defense Administration (FCDA) is established in the Office of Emergency Management (OEM), a decade-old organization in the in the EOP. FCDA takes on some civil defense activities previously performed by the National Security Resources Board.
1951	Civil Defense Act of 1950 (64 Stat. 1245).	FCDA is moved out of the EOP and established as an independent agency. The Civil Defense Advisory Council is established.
1952	E.O. 10346 (*Federal Register*, vol. 17, Apr. 19, 1952, p. 3477).	FCDA is given a key role in assisting federal agencies with planning for service provision and continued functioning during emergencies.

Table 1. Organizations Responsible for Homeland Defense 1947-1952[123]

Year	Authority	Organizational Development
1953	E.O. 10427 (*Federal Register*, vol. 18, Jan. 20, 1953, p. 407).	Emergency management authorities previously delegated to the Housing and Home Finance Administrator are redelegated to FCDA. FCDA is given additional responsibilities related to assisting federal, state, and local agencies with developing plans for disasters.
1953	Reorganization Plan No. 3 of 1953.	New ODM is established with the functions of the old ODM as well as those of NSRB, which is abolished.
1955	E.O. 10638 (*Federal Register*, vol. 20, Oct. 13, 1955, p. 7637).	ODM is given additional responsibilities related to releasing materials from stockpiles in the event of an enemy attack.
1956	E.O. 10660 (*Federal Register*, vol. 21, Feb. 18, 1956, p. 1117).	ODM is given responsibility for the newly established National Defense Executive Reserve.
1958	Reorganization Plan No. 1 of 1958.	All emergency management authorities of ODM and FCDA are transferred to the President, and these two organizations and CDAC are consolidated into the Office of Defense and Civilian Mobilization (ODCM) in the EOP.
1958	E.O. 10773 (*Federal Register*, vol. 23, July 3, 1958, p. 5061).	The authorities transferred to the President by Reorganization Plan No. 1 of 1958 are redelegated to ODCM. The Defense and Civilian Mobilization Board, comprising the ODCM Director and heads of federal departments and agencies, is established.
1958	72 Stat. 861; E.O. 10782 (*Federal Register*, vol. 23, Sept. 10, 1958, p. 6971).	Congress renames ODCM the Office of Civil and Defense Mobilization (OCDM), and the President issues an executive order amending previous orders to reflect this change.
1961	E.O. 10952 (*Federal Register*, vol. 26, July 22, 1961, p. 6577).	Certain civil defense functions are redelegated to the Secretary of Defense. The Secretary of Defense establishes the Office of Civil Defense (OCD) to administer these functions.

Table 2. Organizations Responsible for Homeland Defense 1953-1961[124]

[122] Henry B. Hogue and Keith Bea, *Federal Emergency Management and Homeland Security Organization: Historical Developments and Legislative Options*, p.18.

[123] Ibid., p.37.

[124] Ibid., p.38.

Year	Authority	Organizational Development
1961	E.O. 10958 (*Federal Register*, vol. 26, Aug. 16, 1961, p. 7571).	Certain medical stockpile and food stockpile functions are redelegated from OCDM to the Secretary of Health, Education, and Welfare and the Secretary of Agriculture, respectively.
1961	75 Stat. 630.	Congress renames OCDM the Office of Emergency Planning (OEP).
1962	E.O. 11051 (*Federal Register*, vol. 27, Oct. 2, 1962, p. 9683).	The advisory and management functions of OEP are reaffirmed and expanded.
1964	Administrative authority.	OCD is moved from the Office of the Secretary of Defense to the Department of the Army.
1968	82 Stat. 1194.	Congress renames OEP the Office of Emergency Preparedness.
1969	Disaster Relief Act of 1969 (83 Stat. 125).	The federal government's disaster relief responsibilities are expanded.
1969	E.O. 11495 (*Federal Register*, vol. 34, Nov. 20, 1969, p. 18447).	The administration of many provisions of the Disaster Relief Act of 1969 is delegated to OEP.
1972	Administrative authority.	OCD, then located in the Department of the Army, is abolished. In its place, the Defense Civil Preparedness Agency (DCPA) is established within the Office of the Secretary of Defense.
1973	Reorganization Plan No. 1 of 1973.	Among other provisions, the plan abolishes OEP, and nearly all functions previously vested in that office or its director are transferred to the President. The plan also abolishes the Civil Defense Advisory Council, which had been established in 1950.
1973	E.O. 11725 (*Federal Register*, vol. 38, June 29, 1973, p. 17175).	The functions transferred to the President by Reorganization Plan No. 1 of 1973 are delegated to the Department of Housing and Urban Development (HUD), the General Services Administration (GSA), and the Department of the Treasury.

Table 3. Organizations Responsible for Homeland Defense 1961-1973[125]

Year	Authority	Organizational Development
1978	Reorganization Plan No. 3 of 1978.	The President proposes, and Congress agrees to, the merger of five agencies from the Departments of Defense, Commerce, and Housing and Urban Development, as well as GSA, into one new independent agency, the Federal Emergency Management Agency (FEMA).
1979	E.O. 12127 (*Federal Register*, vol. 44, Apr. 3, 1979, p. 19367).	To implement Reorganization Plan No. 3 of 1978, certain functions are transferred to FEMA from the Department of Commerce (fire prevention and control; certain Emergency Broadcast System functions); the Department of Housing and Urban Development (flood insurance); and the President (other Emergency Broadcast System functions).
1979	E.O. 12148 (*Federal Register*, vol. 44, July 24, 1979, p. 43239).	To implement Reorganization Plan No. 3 of 1978, additional functions from the Departments of Defense (civil defense) and Housing and Urban Development (federal disaster assistance), GSA (federal preparedness), and the Office of Science and Technology Policy (earthquake hazards reduction) are transferred to FEMA. FEMA is also authorized to coordinate "all civil defense and civil emergency planning, management, mitigation, and assistance functions," in addition to dam safety, "natural and nuclear disaster warning systems," and "the coordination of preparedness and planning to reduce the consequences of major terrorist incidents." The Federal Emergency Management Council, composed of FEMA and Office of Management and Budget Directors, and others as assigned by the President, is established.
1993	Authority of the FEMA Director	The National Preparedness Directorate, the entity concerned with national security emergencies, is eliminated.
1996	Authority of the President to establish Cabinet membership.	The President extends Cabinet membership to the FEMA Director.
2001	Authority of the President to establish Cabinet membership.	The incoming President does not extend Cabinet membership to the FEMA Director as he establishes his Administration.

Table 4. Organizations Responsible for Homeland Defense 1978-2001[126]

[125] Henry B. Hogue and Keith Bea, *Federal Emergency Management and Homeland Security Organization: Historical Developments and Legislative Options*, p.39.

[126] Ibid., p.40.

Year	Authority	Organizational Development
2001	Authority of FEMA Director	The President asks the FEMA Director to form an Office of National Preparedness, which was to "coordinate all Federal programs dealing with weapons of mass destruction consequence management." [Joe M. Allbaugh, Memorandum to All FEMA Employees, "Functional Realignment," June 5, 2001, Attachment C, p. 1.]
2002	The Homeland Security Act of 2002 (P.L. 107-296, 116 Stat. 2135).	The Department of Homeland Security (DHS) is established. The functions, personnel, resources, and authorities of six existing entities, the largest of which is FEMA, are transferred into the Emergency Preparedness and Response Directorate. Section 507 of the act specifically charges FEMA with "carrying out its mission to reduce the loss of life and property and protect the Nation from all hazards by leading and supporting the Nation in a comprehensive, risk-based emergency management program."
2003	Department of Homeland Security Reorganization Plan.	The Homeland Security Act of 2002 is implemented, and FEMA functions are transferred to DHS on Mar. 1, 2003.
2004	Authority of the Secretary of Homeland Security under Section 872 of the Homeland Security Act of 2002.	Within DHS, organizational units are consolidated, and functions are reallocated. Among other changes, "select grant award functions ... exercised by the Under Secretary for Emergency Preparedness and Response," under Sections 502 and 503 of the Homeland Security Act, are consolidated within the Office of State and Local Government Coordination and Preparedness, an office that is to report directly to the Secretary.
2005	Authority of the Secretary of Homeland Security under Section 872 of the Homeland Security Act of 2002.	Most preparedness functions housed in the EPR Directorate are transferred to a newly created Preparedness Directorate. FEMA becomes a freestanding unit, headed by a director, within DHS. The FEMA Director reports directly to the Secretary of Homeland Security and directly oversees three divisions (Response, Mitigation, and Recovery) and numerous offices.
2006	Authority of the Secretary of Homeland Security under Section 872 of the Homeland Security Act of 2002.	The position of Under Secretary for Emergency Preparedness and Response is renamed Under Secretary for Federal Emergency Management. The FEMA Director is placed in this position.

Table 5. Organizations Responsible for Homeland Defense 2001-2006[127]

B. DEPARTMENT OF HOMELAND SECURITY AND UNITED STATES NORTHERN COMMAND

The threats the United States faces today are different than what the country faced during World War II and the Cold War. Perceived threats to the United States before 9/11 came almost exclusively from nation-states and the dominant U.S. organizational construct for national security was firmly focused on classic military versus military confrontations. Libya or other states that sponsored terrorism were not considered dangerous enough to prompt a change in our organizational philosophy. But the terrorist attacks of 9/11 demonstrated that non-state actors were now a significant threat. Lethality and wartime hardships could no longer be linked exclusively to another state's conventional military might. As was demonstrated by the 9/11 attackers, a few individuals were able to attack the United States from within using its own resources and infrastructure.

In the fall of 2001**,** the administration of President George W. Bush examined the structure of the federal government and determined that the existing security arrangements were not sufficient to meet the new terrorist threats of the 21st century.

[127] Henry B. Hogue and Keith Bea, *Federal Emergency Management and Homeland Security Organization: Historical Developments and Legislative Options*, p.41.

Before November 2002 “no single government agency had homeland security as its primary mission. In fact, responsibilities for homeland security were dispersed among more than 100 different government organizations.”[128] To consolidate this dispersed domestic security apparatus, the Bush Administration returned to the model set by President Truman in the National Security Act of 1947 by commissioning a single, unified homeland security department. On November 25, 2002, President Bush signed the Homeland Security Act and created a cabinet position for its secretary. According to the Department of Homeland Security, “the creation of the Department of Homeland Security is the most significant transformation of the U.S. government in over a half-century by largely transforming and realigning [a] confusing patchwork of government activities into a single department whose primary mission is to protect our homeland." [129]

The creation of the Department of Homeland Security charged one agency with the responsibility for protection of the homeland. But the legislation did not address the domestic role of the military that, throughout American history, has played an integral role in homeland protection. Prior to the terrorist attacks, the United States Joint Forces Command was charged with the responsibility for defense of the continental United States as part of its North Atlantic regional responsibility. In order to give a DoD organization the same centralized focus as the Department of Homeland Security, that is, charging a single entity with the protection of the homeland, DoD had to modify the Unified Command Plan. Those modifications were the largest since 1983 and were completed on April 17, 2002 with the creation of the United States Northern Command (NORTHCOM).[130]

NORTHCOM became operational as the combatant command for defense of the United States on October 1, 2002, adapting a mission to "Conduct operations to deter, prevent, and defeat threats and aggression aimed at the United States, its territories and interests within the assigned area of responsibility (AOR); and as directed by the

128 The White House, “The Department of Homeland Security.” http://www.whitehouse.gov/deptofhomeland/sect1.html, (accessed 28 February 2006).

129 Ibid.

130 Colonel Daniel Smith, “The Impact of Sept. 11, 2001, on the Unified Command Plan,” Center for Defense Research, (22 May 2002). http://www.cdi.org/terrorism/ucp.cfm (accessed on 28 February 2006).

President or Secretary of Defense, provide defense support of civil authorities including consequence management operations."[131] Though the creation of NORTHCOM and the development of NORTHCOM's mission statement were direct responses to the terrorist attacks of 2001, it was very clear that this new command was not intended to burden the military with new missions. Chairman of the Joint Chiefs of Staff, General Richard B. Myers, remarked at a special briefing on the Unified Command Plan, on April 17, 2002, that "no new missions or roles are being created here for the Department of Defense in creation of this new command… it takes the various homeland security missions being performed by various combatant commanders and some agencies and puts them under one commander, and so we bring unity and focus to the mission."[132]

The bureaucratic and military organizational changes were designed to clarify the responsibility for executing the *National Strategy for Homeland Security*. This clearly stated goal, however is not as simple as it appears once the *National Strategy for Homeland Security* is examined in detail.

C. NATIONAL STRATEGY FOR HOMELAND SECURITY

President Bush's introduction to the *National Strategy for Homeland Security* says that "this is a national strategy, not a federal strategy. We must rally our entire society to overcome a new and very complex challenge."[133] The creation of the Department of Homeland Security and NORTHCOM clarifies the chain of command when coordinating federal government and military responses, but the strategy does not go beyond defining broad activities when specifying organizational responsibilities.

"The strategic objectives of the *National Strategy for Homeland Security,* in order of priority, are to prevent terrorist attacks within the United States, reduce America's vulnerability to terrorism, and minimize the damage and recover from attacks that do

131 U.S. Northern Command, "About Us," http://www.northcom.mil/about_us/about_us.htm (accessed 28 Feb 2006).

132 Department of Defense News Transcript, "Special Briefing on the Unified Command Plan," April, 17 2002. http://www.defenselink.mil/transcripts/2002/t04172002_t0417sd.html (accessed 20 November 2006).

133 Office of Homeland Security, *National Strategy for Homeland Security,* Washington, D.C.: Government Printing Office, 2002. p.iii.

occur."[134] Under these objectives it lists "six critical mission areas: intelligence and warning, border and transportation security, domestic counterterrorism, protecting critical infrastructure, defending against catastrophic terrorism, and emergency preparedness."[135] Though the creation of the Department of Homeland Security merged 22 agencies and approximately 180,000 people into a single entity, [136] it did not include the DoD and its vast capabilities even though the objectives were, in large part, military.

The approach used to reach the strategic objectives within the *National Strategy for Homeland Security* is multi-layered and the strategy relies upon a combination of military and non-military government agencies to counter threats as far away from the continental U.S. as possible. The first line of defense is deterrence, which can be accomplished through the show of military force or diplomatic efforts. If deterrence fails, detecting hostile activities in advance of an attack and as far from the homeland as possible is the best possible outcome. The military and the civilian intelligence community are both well equipped to detect hostile activity. Should detection fail, engaging terrorists directly with force as far from the homeland as possible and defeating them is the last resort for preventing an attack. In the worst case scenario, the last line of defense is a robust capability to quickly recover and mitigate the damage or effects of an attack.

Federal agencies, the military, state, and local governments' emergency services all play a part in the execution of the *National Strategy for Homeland Defense*. Because this strategy interconnects so many different organizations it is important to distribute responsibilities with and within involved agencies. The broadest means of achieving this clearly is by differentiating between security and defense. Homeland security is defined as "a concerted national effort to prevent terrorist attacks within the United States, reduce America's vulnerability to terrorism, and minimize the damage and recover from attacks

134 Office of Homeland Security, *National Strategy for Homeland Security*, pp.vii.

135 Ibid., pp.viii-x.

136 Steve Kingsly, "Homeland Security Act Approved," Homeland Defense Journal, Vol 1, Issue 21, November20, 2002, p.1. http://www.homelanddefensejournal.com/archives/pdfs/Nov_20_vol1_iss21.pdf (accessed 21 November 2006).

that do occur."[137] The Department of Defense defines Homeland Defense as "the protection of United States sovereignty, territory, domestic population, and critical infrastructure against external threats and aggression or other threats as directed by the President."[138] Since these definitions separate federal, state and local governments from the DoD and the DoD is the predominant owner/user of unmanned aerial systems, a closer look at the military's role in such an interrelated strategy is warranted.

D. MILITARY ROLE IN HOMELAND DEFENSE AND SECURITY

The DoD has played a vital role in defending the U.S. homeland throughout its history as was described in the first section of this chapter. The Department of Defense "contributes to homeland security through its military missions overseas, homeland defense, and support to civil authorities."[139] In less formal parlance, defense of the nation since September 11, 2001 can be viewed as an "away game" and a "home game." Forward-deployed U.S. military forces fulfill the first priority of the *National Strategy for Homeland Security* as the first line of defense against those that have hostile intentions toward the U.S. government. However, the homeland defense missions and support to civil authorities are the areas most relevant to this thesis.

Homeland defense utilizes the nation's military forces to deter, detect, and defeat those who would attack United States territory. Defense roles can be broken down further into air and space, land, and maritime domains. Air and space capabilities are robust and have been developed over time as a result of Cold War threats. The North American Aerospace Defense Command is responsible for detecting air and space based threats and is commanded by the NORTHCOM commander.[140] Defense of the land areas and populations are initially protected by law enforcement agencies due to legal restriction that will be discussed at length in the next chapter. Land force readiness is, however, maintained for instances when they are required by the President under extraordinary circumstances. The maritime defense mission detecting threats and

137 Office of Homeland Security, *National Strategy for Homeland Security*, p. 2.

138 Joint Publication 1-02, "DOD Dictionary of Military and Associated Terms," p.243.

139 Office of Homeland Security, *National Strategy for Homeland Security*, p.13.

140 Department of Defense News Transcript, "Special Briefing on the Unified Command Plan."

defending more than 95,000 miles of shoreline, over 1000 harbor channels, and more than 300 ports,[141] has fallen to the Navy in coordination with the Coast Guard.

Another related mission area important to military forces is the security of defense critical infrastructure. In most cases this responsibility falls to the installation commander who has responsibility for critical infrastructure housed within his installation. In some instances however, the infrastructure resides outside of military installations and is important to national infrastructure, not just defense infrastructure.

Civil Support is a term that broadly defines military assistance to non-military entities. Overarching guidance is published in the form of DoD Directive, 3025.15, Military Assistance to Civil Authorities. It defines military support to civil authorities as "those activities and measures taken by the DoD Components to foster mutual assistance and support between the Department of Defense and any civil government agency in planning or preparedness for, or in the application of resources for response to, the consequences of civil emergencies or attacks, including national security emergencies."[142] As was indicated earlier in the discussion regarding land forces and law enforcement, the American style of response to catastrophic events is to handle consequence management at the lowest level of government as possible. This stands to reason since crises, like politics, are local. Once the resources of the local responding government are exceeded, other, likely higher levels of government will attempt to assist. If the consequence management requirements exceed the capability of local or state authorities, the federal government and military can provide assistance via specific legislative authority. Multiple DoD directives dictate how requests for military assistance have to be requested, evaluated, and executed. Three of the major directives are *Military Assistance to Civil Authorities*, *Military Support to Civil Law Enforcement*, and *Military Assistance for Civil Disturbances*.

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141 U.S. Department of Transportation, *An Assessment of the U.S. Marine Transportation System: A Report to Congress*, (Washington, D.C: U.S. Department of Transportation, September 1999), pp.11, 62. http://www.marad.dot.gov/publications/MTSreport/mtsfinal.pdf (accessed 8 October 2006).

142 U.S. Department of Defense, DoD Directive 3025.15, *Military Assistance to Civil Authorities*, (Washington, D.C.: Government Printing Office, February 1997), section E2.1.9.

The increasing role of the military in disaster relief and defense operations has evolved over time to, in part, meet the demands and requirements of increasingly urbanized society. Response to disasters, as noted previously, began with the legislative branch issuing ad hoc legislation. The constant demand for faster government response to disasters has helped force a shift of response authority to the executive branch. To meet the need for an ever increasing demand for real time information, unmanned aerial systems offer real time informational capabilities for all six of the critical mission areas listed in the *National Strategy for Homeland Security*. Even though DoD directives have been crafted to outline the legal methodology to employ the military domestically, determining the applicability of the military and UASs to specific mission sets requires a review of the laws and policies that affect their use.

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IV. LEGAL RESTRICTIONS FOR UNMANNED AERIAL SYSTEMS IN HOMELAND DEFENSE MISSIONS

A. NATIONAL CRISIS RESPONSE AND THREAT TO CIVIL LIBERTIES

In spite of, or due to, the legislative activity since September 11, 2001, the argument between national security requirements and the maintenance of civil liberties has reached a crescendo. Former U.S. Supreme Court Chief Justice William Rehnquist wrote, "There is every reason to think that the historic trend against the least justified of the curtailments of civil liberty in wartime will continue in the future. It is neither desirable nor is it remotely likely that civil liberty will occupy as favored a position in wartime as it does in peacetime. But it is both desirable and likely that more careful attention will be paid by the courts to the basis for the government's claims of necessity as a basis for curtailing civil liberty."[143] Before September 11, 2001, concerns about the imposition of security needs on civil liberties and privacy were muted. But, once the immediate terrorist threat passed, a lively debate over the impact of security imperatives upon civil liberties gained momentum, with the argument focusing upon determining a viable balance between security and the protection of privacy as guaranteed in the Constitution. UASs, as an effective means for detecting illegal activities along our borders and territorial waters, and for monitoring myriad activities throughout the country, are at risk of being ensnared by the Constitutional debate.

This debate is long-standing, and significant precedents exist to guide the development and domestic deployment of UASs. Unfortunately, these precedents suggest an unhealthy oscillation between one extreme or the other. As far back as 1798, the Sedition Act "prohibited the publication of false, scandalous, and malicious writings against the government, the Congress, or the President with the intent to bring them into contempt or disrepute."[144] Citizens were convicted under this Act, despite their first amendment protection. To correct that imbalance, President Thomas Jefferson "pardoned

[143] William R. Rehnquist, *All the Laws But One: Civil Liberties in Wartime,* 1st ed. (New York, Knopf, 1998), pp.224-225.

[144] James J. Carafano, and Paul Rosenzweig, *Winning the Long War: Lessons from the Cold War for Defeating Terrorism and Preserving Freedom*. (Washington D.C.: Heritage Books, 2005), p.85.

all those who were convicted under the act."[145] During World War I, the United States "prosecuted more than 2000 people under the Espionage Act for their opposition to the war,"[146] but no Presidential pardons were handed out to those convicted.[147] Although the U.S. Supreme Court initially approved most federal decisions in support of the war, over the next fifty years, the Court overruled everyone of its World War I decisions– effectively repudiating the excess of that wartime era."[148] At the beginning of World War II, thousands of Japanese-Americans were forced from their homes and sent to internment camps for fear of what they might do out of loyalty to Japan. "In 1988, President Ronald Reagan offered an official presidential apology and reparations to each of the Japanese-American internees."[149]

In 1976, Senator Frank Church (D-Idaho) chaired a Senate Committee and produced a report entitled *Intelligence Activities and the Rights of Americans*, known as the Church Report, that revealed civil liberty abuses and the evolution of domestic intelligence.[150] The report indicated that intelligence collection was conducted and overseen by the Executive Branch without congressional oversight from 1936 to 1976. Identifying subversive activities was the objective of the executive branch until the end of World War II, when disruption of subversives was added to the focus. The report found that activities conducted in the name of national security often went far beyond what was relevant or necessary for a specific purpose and that "significant weaknesses in the system of accountability and control within the intelligence community allowed pervasive abuses of the privacy and liberties of U.S. citizens."[151] The report concluded

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[145] James J. Carafano, and Paul Rosenzweig, *Winning the Long War: Lessons from the Cold War for Defeating Terrorism and Preserving Freedom*. (Washington D.C.: Heritage Books, 2005). p.85.

[146] Ibid., p.86.

[147] Ibid.

[148] Ibid. (Legal examples include Schenk v. U.S., 249 U.S. 47 (1919); Debs v. U.S., 249 U.S. 211 (1919); Brandenburg v. Ohio, 395 U.S.444 (1969).).

[149] Ibid.

[150] Select Committee to Study Governmental Operations with Respect to Intelligence Activities, United States Senate, *Intelligence Activities and the Rights of Americans*, bk. 2 (Washington, D.C.: 1976). (Subsequently referenced as The Church Report).

[151] The Church Report.

that officials "frequently disregarded the law in their conduct of massive surveillance"[152] and that "all too often improper programs were terminated only in response to exposure, the threat of exposure, or a change in the climate of public opinion, such as that triggered by the Watergate affair."[153]

The intelligence oversight laws enacted after the Church Report, notably Executive Order 12333 in 1981, strived "to limit the number of intelligence agencies permitted to collect information on U.S. persons…and to increase control over domestic intelligence collection."[154] This order, along with the National Security Act of 1947, limited domestic intelligence collection to the FBI and was the first significant step toward separating proactive intelligence from reactive law enforcement. In 1976, U.S. Attorney General Edward H. Levi published guidelines for the FBI, which limited its investigations to those that had links to criminal activity. In 1978, Congress passed the Foreign Intelligence Surveillance Act (FISA) that created the FISA court and required the government to obtain a court order before conducting electronic surveillance on a U.S. person. This created a legislative wall between the intelligence mission assigned to the CIA and the law enforcement focused FBI. With such restrictions and oversight in place it appeared that civil liberty protection was in place and balance was again attained.

Since 1976, organizational distinctions developed that highlighted the differences between intelligence and law enforcement agencies. The purpose of intelligence is to assist in the propagation of informed policy, whereas law enforcement is focused on the prosecution of criminal cases. In general, intelligence activities are conducted before an event and law enforcement activities are conducted after. The legal standard for intelligence is "good enough" while law enforcement uses judicial rules and principals of reasonable doubt. Intelligence does not reveal sources in order to protect sources and methods. Law enforcement makes evidence public to gain convictions. The separation of functions by agency and these key differences in operational methodology balanced

[152] The Church Report.

[153] The Church Report.

[154] U.S. President, Executive Order, "United States Intelligence Activities, Executive Order 12333," Federal Register 46, no. 59941 (4 December 1981).

the security versus civil liberty debate until the terrorist attacks in 2001. Ironically, the separation of these functions helped facilitate terrorist operations within the U.S..[155]

New legislation was enacted that brought the civil liberties debate, once again, to the forefront. The USA PATRIOT Act of 2002 blurred the lines between law enforcement and intelligence gathering by encouraging agencies to share information.[156] The Homeland Security Act of 2002 realigned the intelligence community under a single Director of National Intelligence and created the Terrorist Threat Integration Center within the Central Intelligence Agency. This center collects and analyzes all intelligence related to terrorist threats gained from both foreign and domestic sources.[157] *The Attorney General's Guidelines for General Crimes* was revised and now permits the FBI to collect public information about U.S. residents and conduct surveillance in public places without a link to suspected criminal activity.[158] Sunset provisions required Congress to actively renew parts of the USA PATRIOT Act and the more robust oversight architecture is comforting to some, but others are fearful of history's mistakes with today's technology.

A primary concern is that technology may unduly impact upon individual liberties. Fears of unrestricted and constant video surveillance, loss of genetic privacy, compilation of biometric identification, instant radio frequency identification and data profiling are widespread, making any domestic UAS deployment difficult. UAS sensor capabilities allow for individuals to be observed, regardless of whether they are the primary target or are incidental as part of the public domain. Critics point to the use of security cameras on the streets of Glasgow, Scotland and cite their ineffectiveness in reducing criminal activity overall.[159] Others claim that the closed circuit cameras put in place in Manhattan and Washington DC cannot guarantee that camera systems will

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[155] Dr Gregory Treverton, RAND Corp/former VP of National Intelligence Council, Naval Postgraduate School presentation, 13 March 2006.

[156] USA PATRIOT ACT, Public Law 56, 107th Cong., 1st sess., (26 October 2001).

[157] Homeland Security Act of 2002, Public Law 296, 107th Cong., 1st sess., (14 November 2002).

[158] Office of the Attorney General, *The Attorney General's Guidelines on General Crimes, Racketeering Enterprise and Domestic Security/Terrorism Investigations*, 21 March 1989. www.usdoj.gov/ag/readingroom/generalcrimea.htm (accessed October 23, 2005).

[159] Scottish Office Central Research Unit, "Crime and Criminal Justice Research Findings No. 30," (7 July 1999). http://www.scotcrim.u-net.com/researchc2.htm (accessed 17 March 2006).

increase security.[160] An accompanying fear is that the courts will not be able to keep up with rapidly advancing technology. In an important pre-9/11 case, Kyllo vs. U.S., the Supreme Court held that the reasonable expectation of privacy could not be determined by the power of new technologies.[161] More simply put, just because a technological advancement gives us the capability to detect something, that capability does not necessarily mean that we should use it in an indiscriminate fashion.

The fourth amendment of the United States Constitution is usually referenced for privacy rights, but the word "privacy" is not used in the amendment. It does state "the right of the people to be secure in their persons, houses, papers, and effects against unreasonable searches and seizures, shall not be violated, and no warrants shall issue, but on probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the person or things to be seized."[162] "Our current understanding of how the Fourth Amendment protects privacy is based on a 1967 Supreme Court ruling in which Justice John Harlan argued that there must be "a reasonable expectation of privacy" in order to require a warrant under the Fourth Amendment."[163]

Public opinion polls can be found in support of either side of the security versus civil liberty debate. The fear that people express about government abuses of power in this respect are difficult to assess. "Perhaps the best that can be said about public opinion is that there is neither overwhelming opposition nor support for increased government surveillance of suspected terrorist activity."[164] The U.S. Constitution and legislation discussed indicates that state surveillance on U.S. persons is legal and guidelines exist for conducting surveillance.

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[160] Jay Stanley and Barry Steinhart, "Bigger Monsters, Weaker Chains: The Growth of an American Surveillance Society," American Civil Liberties Union. http://www.aclu.org/Privacy/Privacy.cfm?ID=11573&c=39 (accessed 25November 2006).

[161] Ibid.

[162] US Constitution, amend. 4. http://www.usconstitution.net/const.html#Am4 (accessed 19 March 2006).

[163] Michael Freeman, "Counterterrorism and Privacy: The Changing Landscape of Surveillance and Civil Liberties", in *Information Ethics: Privacy and Intellectual Property*, Lee Freeman and A. Graham Peace, Hershey, Pa, 2005. p.165.

[164] Ibid,. p.169.

"To detect and track anticipated air and maritime threats effectively, the United States must have capabilities to cue, surveil, identify, engage, and assess potential threats in real time."[165] This pressure to fill this immediate need, however, must be weighted against the longstanding threat of judicial constraint of UAS operational activities. Legal and historical precedent suggests that the U.S. democratic system, when facing competition between security imperatives and civil liberties, oscillates between perceived security excess followed by a public backlash and legal or executive restraints. Therefore, uninhibited adoption of UASs in the U.S. could spark a backlash. With the wide array of sensor capabilities, along with the ubiquity and persistence of UA systems, opportunities exist for UAS operations to be perceived by the public as excessively intrusive. Even judicious and limited UAS use may raise questions about domestic civil liberties that operators may not desire—even though the legal authority of potential operators are likely to nullify legal challenges.

B. LEGAL RESTRICTIONS ON THE MILITARY'S DOMESTIC ROLE

The U.S. Constitution establishes the fundamental justification for utilizing military forces in all aspects of homeland security. In the Preamble, the Constitution specifically states that its purposes include "to ensure domestic tranquility and provide for the common defense."[166] In furtherance of these ends, Article I, Section 8 of the Constitution, grants Congress "the legislative authority to "provide for the common defense and general welfare of the United States…declare war…raise and support armies…provide and maintain a navy…[and] provide for calling forth the militia to execute the laws, suppress insurrections, and repel invasions."[167] Article II, Section 3 empowers the President and Commander in Chief with executive authority to take care that "the laws be faithfully executed;"[168] and Article IV, Section 4 requires the federal government to protect states against invasion and domestic violence upon request.[169] The legal basis for military support in domestic security generally derives from a

[165]U.S. Department of Defense, *Strategy for Homeland Defense and Civil Support*. (Washington D.C., June 2005). p.21.

166 U.S. Constitution, preamble.

167 U.S. Constitution., art. 1, sec. 8.

168 U.S. Constitution., art. 2., sec. 3.

169 U.S. Constitution., art. 4, sec. 4.

Congressional statute or the President's executive authority. Historical instances where this did not occur was the reason for a nineteenth century law called the Posse Comitatus Act.

The Posse Comitatus Act (PCA) of 1878 is widely misunderstood. The law in its entirety is as follows:

> Whoever, except in cases and under circumstances expressly authorized by the Constitution or Act of Congress, willfully uses any part of the Army or the Air Force as a posse comitatus or otherwise to execute the laws shall be fined under this title or imprisoned not more than two years, or both.[170]

It is surprising that such a short text could be so widely misunderstood. "Posse comitatus means, literally, the "force of the county"; and is that body of men above the age of 15 whom the sheriff may summon or raise to repress a riot or for other purposes."[171] "Its origins in the United States date back to 1854 when Attorney General Caleb Cushing offered an opinion that U.S. marshals could summon a posse comitatus and that both militia and regulars in organized bodies could be members of such a posse."[172] His opinion was in support of better enforcement of the Fugitive Slave Act of 1850. Since the U.S. government was responsible for payment of those enlisted into a posse Comitatus by a U.S. Marshal, the use of the Army and Navy was actually encouraged. The largest use of the posse comitatus was in the west, since law enforcement was scarce and the environment was extremely dynamic.[173]

During the reconstruction period after the Civil War, the federal military occupied the 11 southern states that were part of the confederacy and provided law enforcement since their state militias were unable. "After 1868, when all but three of the Southern states had been readmitted to the union,"[174] law enforcement increasingly became a

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170 Posse Comitatus Act, U.S. Code 18 (1878) §1385.

171 John Brinkerhoff, "The Posse Comitatus Act and Homeland Security," Journal of Homeland Security, (13 September 2005). http://www.homelandsecurity.org/newjournal/articles/brinkerhoffpossecomitatus.htm (accessed 18 March 2006).

172 Ibid.

173 Ibid.

174 Ibid.

problem since the status of the Army had changed. "Attorney General of the United States, William M. Evarts, cited the posse comitatus doctrine that gave U.S. marshals and county sheriffs the right to command all necessary assistance from within their districts, including military personnel and civilians, to serve on the posse comitatus to execute legal process."[175] That opinion led to numerous requests by marshals and county sheriffs for troops to aid in enforcing the law without requiring presidential authority. The War Department was wary of this trend and sought to participate only in times that did not require soldiers to subordinate their role as members of a standing military. By the 1876 presidential election, the southern states were capable and eager to resume control over themselves.

After reconstruction ended in 1877, federal troops were withdrawn from the southern states. Congress grew disenfranchised with the excessive use of federal troops as a posse Comitatus without the consent of the president, so in 1878 "representative J. Proctor Knott of Kentucky introduced an amendment to the Army appropriations bill and the amendment eventually became the Posse Comitatus Act. In passing the act, the Congress voted to restrict the ability of U.S. marshals and local sheriffs to conscript military personnel into their posses. They did not vote to preclude the use of troops if authorized by the president or Congress."[176]

Military involvement in direct law enforcement activities is normally prohibited by the PCA and prohibits the use of the military in activities such as: arrest; seizures of evidence; search of persons; search of a building; investigation of a crime; interviewing witnesses; pursuit of an escaped prisoner; search of an area for a suspect and other like activities."[177] "The Posse Comitatus Act, however, has not precluded the military from providing logistical support, technical advice, facilities, training, and other forms of assistance to civilian law enforcement agencies even though that assistance may aid those

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[175] John Brinkerhoff, "The Posse Comitatus Act and Homeland Security," Journal of Homeland Security, (13 September 2005). http://www.homelandsecurity.org/newjournal/articles/brinkerhoffpossecomitatus.htm (accessed 18 March 2006).

[176] Ibid.

[177] Jeffrey D. Brake, *Terrorism and the Military's Role in Domestic Crisis Management: Background and Issues for Congress*, Washington D.C.: Congressional Research Service Report for Congress, 19 April 2001. Library of Congress Congressional Research Service, Order Code RL30938. p.12.

activities. Using a test based upon whether the military's involvement is "active" or "passive," the courts have held that providing assistance as listed above falls in the "passive" category and do not violate the Posse Comitatus Act.[178] In reaffirming the ability to use the military in domestic roles, Congress passed the Homeland Security Act of 2002 and endorsed the PCA as follows:

> The Posse Comitatus Act has served the Nation well in limiting the use of the Armed Forces to enforce the law. Nevertheless, by its express terms, the Posse Comitatus Act is not a complete barrier to the use of the Armed Forces for a range of domestic purposes, including law enforcement functions, when the use of the Armed Forces is authorized by Act of Congress or the President determines that the use of the Armed Forces is required to fulfill the President's obligations under the Constitution to respond promptly in time of war, insurrection, or other serious emergency.[179]

"In March 2003, the Commander of U.S. Northern Command stated, "We believe the [Posse Comitatus] Act, as amended, provides the authority we need to do our job, and no modification is needed at this time." On May 29, 2003, DoD informed Congress of the results of its legal review, which concluded that the President has sufficient authority to order the military to provide military support to civilian law enforcement authorities, when necessary. DoD does not believe that the Posse Comitatus Act would in any way impede the nature or timeliness of its response."[180] An important aspect of the PCA is who it affects. The original act identified the Army and was later amended to include the Air Force. The Navy and Marine Corps were not included in the act's language, but the DoD considers it to apply to them as well. Generally speaking, those in federal military service (Title 10) are subject to PCA restrictions. The state militias are not since they are under the control of the state governor (Title 32) and restrictions also do not apply to the United States Coast Guard (USCG) since they have federal law enforcement authority.[181]

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178 Jeffrey D. Brake, *Terrorism and the Military's Role in Domestic Crisis Management: Background and Issues for Congress*, Washington D.C.: Congressional Research Service Report for Congress, 19 April 2001. Library of Congress Congressional Research Service, Order Code RL30938. p.12.

179 Homeland Security Act of 2002, Public Law 296, 107th Cong., 1st sess., Section 886, (14 November 2002).

180 General Accounting Office, *DoD Needs to Assess the Structure of U.S. Forces for Domestic Military Missions*, (Washington, D.C.: U.S. General Accounting Office, July 11, 2003), p. 12.

181 DOD Directive 5525.5, *DoD Cooperation with Civilian Law Enforcement Officials*; (Washington, D.C.: Government Printing Office, January 1986).

As has been shown, the authority for the military to protect the United States is derived from the constitution, but domestic roles less than engaging a hostile foreign force is restricted by the PCA. To illustrate how the DoD executes its “passive” role providing Military Assistance to Civil Authorities, further analysis of DoD Directives is required.

NORTHCOM's stated mission is to "conduct operations to deter, prevent, and defeat threats and aggression aimed at the United States, its territories, and interests within the assigned area of responsibility; and as directed by the President or Secretary of Defense, provide military assistance to civil authorities including consequence management operations."[182] In order to conduct this mission with military forces domestically, the DoD has published several directives that outline the roles the military is authorized to conduct and the process for requesting military assistance.

Military Assistance to Civil Authorities (MACA), DoDD3025.15, serves as the basis for DoD policy. Specific guidance is generally addressed under three categories: *Military Support to Civil Authorities* (MSCA), DoDD 3025.1, *Military Assistance for Civil Disturbances* (MACDIS), DoDD 3025.12, and 10, USC, Chapter 18, section 375, *Military Support to Civil Law Enforcement Agencies* (MSCLEA). The MSCLEA category is the most relevant to military operations of UASs since it includes guidance for national critical infrastructure protection, maritime security, support for combating terrorism, and border patrol/mass immigration missions. Also relevant is Executive Order 12333, *United States Intelligence Activities*, since it serves as overarching guidance for the goals and actions of the intelligence community. One of its main functions is to charge the heads of intelligence departments to provide specific guidance for implementing EO12333. The Secretary of Defense accomplished this regulatory requirement in the form of Department of Defense Instruction (DoDI) 5240.1-R, *Procedures Governing the Activities of DOD Intelligence Components That Affect United States Persons*, which sets the ground rules for military intelligence analysts use of information collected on "U.S. persons." Additional guidance relevant to the intelligence community is DoD Directive (DoDD) 5240.1, *DoD Intelligence Activities*, DoDD 5200.27, *Acquisition of Information Concerning Persons and Organizations not*

182 U.S. Northern Command, *U.S. Northern Command's Strategic Vision*, (Colorado Springs, CO, 2003).

Affiliated with DoD, DoDD 5525.5, *DoD Cooperation with Civilian Law Enforcement Officials*, and finally DIAI 5210.001, *Security Classification of Airborne Sensor Imagery*.

All of these directives provide input on the type of support authorized based on the request received. For example, all requests for military support from law enforcement will be evaluated against the following criteria: legality, lethality, risk, cost, appropriateness and readiness.[183] This is important for determining what missions to support and what type of support to offer.

The specifics of each directive are insightful when examined individually, but they gain contextual meaning when their content is applied to an assistance request. For now, it is sufficient to know that the legal framework permitting the use of the military domestically exists. Matching the capabilities of UASs with specific missions will be addressed in chapter 5.

An interesting tone was set during the debates for the 2006 Defense Authorization Bill. The Senate Defense authorization bills (S.1042 and S. 1043), would have added a new section 383 to Title 10, "which would authorize the Secretary of Defense to use unmanned aerial vehicles and DoD personnel to conduct aerial reconnaissance within U.S. Northern Command's area of responsibility, in order to monitor air and sea traffic along the border and coastline, and to communicate resulting information to the appropriate federal, state, and local law enforcement officials."[184] Senator John Warner indicated that the intent was to "enhance the Department's homeland defense capabilities, including: Providing the Secretary of Defense authority to use DoD personnel and equipment to conduct UAV aerial reconnaissance to detect and monitor suspicious air, sea, and surface traffic along the U.S. border."[185] This proposal and the addition of section 383 to Title 10, USC, was however, not included in the FY 2006 Defense

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[183] U.S. Department of Defense, DoD Directive 3025.15, *Military Assistance to Civil Authorities*, (Washington, D.C.: Government Printing Office, February 1997), sections 4.2-4.2.6.

[184] Jennifer Elsea, *The Posse Comitatus Act and Related Matters: A Sketch*, Washington D.C.: Congressional Research Service Report for Congress, 6 June 2005. Library of Congress Congressional Research Service, Order Code RS20590. p.6.

185 United States Senate Website. "FY06 Defense Authorization Bill Summary." U.S. Senator John Warner, (13 May 2005). http://www.senate.gov/~warner/pressoffice/pressreleases/20050513.htm (accessed 18 March 2005).

Authorization Act. The House Resolution 1815 that was signed into law included instead section 1035 and the requirement to study and "Report On Use Of Department Of Defense Aerial Reconnaissance Assets To Support Homeland Security Border Security Missions."[186] This was a significant difference in authority being considered by the House and Senate and future debate after subsequent study will be worth watching.

C. UNMANNED AERIAL SYSTEM OPERATIONS

Laws examined to this point do not prohibit the use of the military domestically or the employment of unmanned aerial systems for law enforcement or intelligence collection. Little adaptation of the current legal structure seems to be required for the military to conduct homeland defense missions or for using UASs as an intelligence collection platform. To realize the maximum effectiveness of UASs, operations need to be conducted under the same "file and fly" flight planning system currently enjoyed by manned aircraft.[187] As bright as the future of unmanned system utilization may be, legal restrictions on the operation of UASs in the U.S. National Airspace System currently prohibit this type of operation.

The National Airspace System is the system of systems, human capital and equipment required to provide for the safe movement of air traffic.[188] Two categories of airspace exist and are called regulatory and nonregulatory. Within these two categories, four types of airspace exist, called controlled, uncontrolled, special use, and other. The categories and types of airspace are designated based on the complexity or density of aircraft movements, the nature of the operations, the level of safety required and the national and public interest.[189] For example, uncontrolled airspace has the lowest pilot

186 FY06 Defense Authorization Act, HR 1815, 109th Cong., 1st sess., Section 1035. http://thomas.loc.gov/cgi-bin/cpquery/?&dbname=cp109&sid=cp109q4Kjj&refer=&r_n=hr360.109&item=&sel=TOC_1120259& (accessed 25 November 2006).

187 Karen Robbins, "National Next Generation Aircraft Technology Program Introducing Remotely Operated Aircraft (ROA) into the National Airspace System (NAS)," White Paper submitted to U.S. Department of Transportation Research and Special Programs Administration (RSPA) Solicitation DTRS56-01-BAA-0002, http://www.erast.com/ehtml/vanguard.html (2 May 2005).

188 General Accounting Office. *National Airspace System: Transformation Will Require Cultural Change, Balanced Funding Priorities, and Use of All Available management Tools.* 14 October 2005. Order No. GAO-06-154. p.16.

189 U.S. Department of Transportation, Federal Aviation Administration, Airman's Information Manual, "Airspace," Government Printing Office. Washington DC. (2006.) p.3-1-1. http://www.faa.gov/ATPubs/AIM/index.htm (accessed 12 June 2006).

certification and aircraft equipment requirements since it overlies unpopulated areas and contains the fewest number of aircraft operations. In contrast, Class B airspace surrounds the country's largest and busiest airports and has the most stringent pilot certification and aircraft equipment requirements. This is due to the large number of aircraft operating in a small area, usually over heavily populated areas. Special Use airspace is usually reserved for military operations that would pose a hazard to civil aircraft, such as aerial gunnery or other live fire areas.[190]

Manned aircraft operate under a concept called "see-and-avoid." "When weather conditions permit, regardless of whether an operation is conducted under instrument flight rules or visual flight rules, vigilance shall be maintained by each person operating an aircraft so as to see-and-avoid other aircraft. When a rule of this section gives another aircraft the right-of-way, the pilot shall give way to that aircraft and may not pass over, under, or ahead of it unless well clear."[191] The issue with unmanned aircraft is that no one is onboard to comply with this directive and unmanned systems do not currently have sufficient "see-and-avoid" or more appropriately "sense-and-avoid" systems. The Federal Aviation Administration (FAA) recognized the need for operating in the National Airspace system and allowed for chase aircraft, ground based radar, or observers in lieu of this requirement. However, these three solutions were impractical outside of the test environment so an alternate procedure was put in place.

The FAA published procedures for special military operation if the form of FAA Order 7610.4. This order established procedures for unmanned aircraft operations within special use airspace called restricted areas and warning areas.[192] In practice, high altitude long endurance vehicles take advantage of this rule with minimal imposition on other air traffic. The aircraft will take off from a military facility, which is protected by special use airspace. It will climb within that airspace until reaching an altitude that is above commercial traffic or into uncontrolled airspace above 60,000 feet mean sea level. Once

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[190] Federal Aviation Administration, Airman's Information Manual. (2006).

[191] US Department of Transportation, Federal Aviation Administration, Federal Aviation Regulations, 14 C.F.R. § 91.113(b). (2006).

[192] U.S. Department of Transportation, Federal Aviation Administration, *FAA Order 7610.4K Special Military Operations, section 12-9-1*. (Aug. 2004).

in this high altitude, uncontrolled airspace it can move freely without interference from other traffic. While this solution is appropriate for systems like the Global Hawk it does not work for most types of unmanned systems. To facilitate their use, an alternate solution was devised.

Unmanned systems that need to operate outside of special use airspace are required to obtain permission from the FAA in a process known as a Certificate of Authorization (COA) contained in FAA Order 7610.4, *Military Operations.* This process requires a case-by-case safety evaluation of each flight, so the process can take weeks to months to approve depending on the FAA region or regions where the flight will take place. A primary consideration in the approval process is the see-and-avoid capability, which usually requires primary radar coverage and/or a chase plane to accompany the UAV. The FAA will issue a time and route of the UAV flight to avoid risks to aircraft and persons on the ground. The process is cumbersome and is incapable of sustaining a high volume of UAV flight requests. As a result, this severely limits the utility and missions of UAVs.[193]

In order to integrate unmanned systems into the National Airspace System either technology has to ensure adequate sense-and-avoid capability or the legal framework of air traffic control has to be adjusted to facilitate UAS use. Science is advancing the former solution as diligently as possible but the solution is not currently available. So, the government is working to safely bridge the gap with regulatory reform, until technology solves the problem. The DoD and FAA are working to classify unmanned aircraft in a manner that fits with the FAA's current regulatory framework. The vehicles will be classified based on their use just as manned aircraft are.

Category I contains smaller vehicles like the Raven or Dragon Eye who generally operate on visual line of sight operations. This category is based on remote control model aircraft and has no regulatory guidance established. The FAA published Advisory Circular 91-57, *Model Aircraft Working Standards*, that outlines voluntary compliance

193 Matthew T. DeGarmo, "Issues Concerning Integration of Unmanned Aerial Vehicles in Civil Airspace," The Mitre Corporation. (Nov. 2004) http://www.mitre.org/work/tech_papers/tech_papers_04/04_1232/04_1232.pdf (accessed 12 June 2006).

measure for operators. These types of operation typically do not occur outside of uncontrolled airspace and pose only a minimal hazard.[194]

Category II contains vehicles such as the Pioneer and Shadow. This category bases its regulatory guidance on purpose built manned aircraft such as the light sport category. They are not certificated with the intent of operating in all weather environments or all airspace classifications. Unlike Category I vehicles, operators are required to show compliance with vehicle airworthiness and operator qualifications. These vehicles would be required to apply for the Certificate of Authorization under FAA Order 7610.4 anytime they intend to operate outside of special use airspace or FAA defined parameters.[195]

Category III vehicles are those that most closely follow the certification standards for manned aircraft. Examples would be the Predator and Global Hawk. Since these systems are built for beyond line of sight operation and are capable of operation in any type of airspace, both the vehicle and operator would have to comply with the same certification standards as manned aircraft. This includes the sense-and-avoid technology that is currently still under development. The goal is for the Category III vehicles to be able to "file and fly" once technology offers that solution. Category II vehicles will still need to operate with the Certificate of Authorization when outside of special use airspace and do not meet on board equipment requirements for the airspace they are using.[196]

Since a large part of the certification category definition is based on the type of airspace they operate in, consideration must also be given to foreign and international airspace. In 1944, the allied and neutral states hosted a meeting in Chicago for all air-faring nations, to standardize the rules for international civil aviation. This document was called the Convention on International Civil Aviation, also known as the Chicago

194 U.S. Department of Defense, *Airspace Integration Plan for Unmanned Aviation*, (Washington, D.C.: Government Printing Office, November 2004). p.58.

195 U.S. Department of Defense, *Airspace Integration Plan for Unmanned Aviation*, pp.48-49.

196 Ibid., p.48.

Convention.[197] This event also established the International Civil Aviation Organization as the oversight body for international civil aviation.

Article 8 of the Chicago Convention addresses pilotless aircraft and reads:

> No aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization. Each contracting State undertakes to ensure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be controlled as to obviate danger to civil aircraft.[198]

This article requires each contracting state to establish rules for unmanned vehicles to enter, transit, and exit the National Airspace System. While in a state's airspace, it also requires that they not create a hazard to other aircraft. Technology has finally caught up with the law and it is time to lay the foundation for unmanned operations. One could argue that this is a significant article in the convention with respect to Homeland Defense missions on the U.S. borders. In the event that civil operators conduct such operations this international law would apply. As the word "civil" in the title of the convention implies, it does not apply to "aircraft used in military, customs and police services,"[199] otherwise defined as "state aircraft." This definition likely arose out of the reluctance of States reluctance to relinquish control of their state aircraft to an international body.[200] In spite of this, unmanned aircraft may, on occasion, be required to operate in the sovereign national airspace of Canada and Mexico along the U.S. border. Sovereign civil airspace is heavily regulated by Article 3, so the time for establishing the legal framework for homeland defense missions is at hand.

The convention also covers operations in international airspace such as that above the high seas. Aircraft are required to operate in accordance with the rules established by their country of registry first. The second expectation is for aircraft to follow the "air

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197 Mark Peterson, "The UAV and the Current and Future Regulatory Construct for Integration Into the National Airspace System," Institute of Air and Space Law, Montreal, Quebec. July 2005. p.41.

198 Convention on International Civil Aviation, Dec. 7, 1944, 61 Stat. 1180, 15 U.N.T.S.295. Article 8.

199 Convention on International Civil Aviation, Dec. 7, 1944, 61 Stat. 1180, 15 U.N.T.S.295. Article 3.

200 Mark Peterson, "The UAV and the Current and Future Regulatory Construct for Integration Into the National Airspace System," p.44.

rules" contained in the convention.[201] Again, this convention does not apply to the military or state aircraft, but legal consideration will be required if private operators conduct such operations.

[201] Mark Peterson, "The UAV and the Current and Future Regulatory Construct for Integration Into the National Airspace System," p.45.

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V. APPLICABILITY OF UNMANNED AERIAL SYSTEMS

A. HOMELAND DEFENSE MISSIONS

Unmanned aerial systems offer flexible ISR and communications capabilities that are appropriate across the spectrum of agencies charged with defending the homeland. There is little doubt that the advanced technology empowering unmanned aerial systems require military and civilian leaders to give serious consideration to their use in order to minimize the time between target detection and engagement. UASs offer technical capability under current legal framework to effectively perform air, land, and maritime defense, and conduct civil support missions as required.

1. Air Defense

The air-to-air combat role executed by fighter aircraft is not in jeopardy of losing this mission to UASs. At some future time, technology may allow for a UAS to perform an interceptor role and engage in aerial combat, but that time is well into the future. Not only will new technology require development, but policy will also have to be amended to allow for armed UASs to be flown domestically. Manned aircraft have historically been a threat to the continental United States, but cruise missiles must also be considered.

Cruise missiles pose a threat to the United States because of their small size, tremendous speed and their ability to be launched from almost anywhere. Cruise missiles are relatively small weapons and are difficult to detect because of their size and small radar cross-section. One launched, cruise missiles can fly at high subsonic and supersonic speeds. Cruise missiles do not need the same infrastructure that Cold War era intercontinental ballistic missiles require. As a result, cruise missiles can be moved to the optimal position relative to a target. Short distances between launch site and target coupled with high speed increases the likelihood of a successful cruise missile attack. At present, UASs do not offer superior solutions over current capabilities for engaging this type of emerging threat.

In the near term, the sole UAS role in air defense will likely employ the use of on-board radar for threat detection. Threat detection in the air domain has historically been accomplished through a combination of over-the-horizon radar systems, aerostats, and

manned aircraft. UASs could substitute for inoperative aerostats or ground based radar, but UAS mobility provides the added benefit of strengthening the radar coverage area where vulnerabilities to fixed radar facilities may exist or radar coverage is insufficient.

Tactical and high altitude, long endurance UASs are suited for air defense, threat detection roles. The MQ-7 Hunter and RQ-5 Shadow are appropriate for threat detection operations that are more tactical in nature, like a coverage of a major sporting event or an event of national significance. As stated in Chapter 2, these medium sized systems operate in the fifteen to twenty thousand foot altitude range and have endurance of less than 10 hours. Their payloads can be tailored for radar packages appropriate for detecting airborne targets or locating the source of shells, mortars or other airborne munitions, and relay information collected to ground stations in real time. The Hunter and Shadow are examples of systems that could be used in specific geographic areas to satisfy tactical requirements. Coverage of larger geographic areas for strategic operations would require larger systems. Global Hawk, a high altitude, long endurance system, could easily satisfy threat identification requirements. As one of the largest systems currently available, the Global Hawk's modular payload capability allows divers mission assignments.

In all cases of UASs used for air defense, operation within the National Airspace System will be required. Currently the Global Hawk is the only UAS with a national Certificate of Authorization. The confirmed advancement of sense-and-avoid technology will expand the possibilities for UAS air defense roles, but current technology limits this capability to missions over routes coordinated with the FAA weeks in advance. Only the smallest UASs, operated below the floor of controlled airspace will not be affected by sense-and-avoid requirements. Their applicability to air defense missions is however unlikely since their communications and threat detection capabilities are far less than larger vehicles. Since the air domain is focused on airborne threats, risks to civil liberties is low.

2. Land Defense

Defense of the land domain has traditionally been relegated to law enforcement rather than military agencies. The United States Customs and Border Protection Service (CBP) is the law enforcement agency responsible for "safeguarding the American

homeland at and beyond,"[202] the border. UASs offer significant capabilities for detecting illegal activity at U.S. international borders. The second major area UASs can contribute within the land domain is critical infrastructure protection. Unlike the border mission, critical infrastructure protection has no dedicated law enforcement agency for its protection. Instead, critical infrastructure protection responsibilities rest in a single office within the Department of Homeland Security whose purpose is to "work with the federal departments and agencies, state and local governments, and the private sector to implement a comprehensive national plan to protect critical infrastructure."[203] The National Strategy for Homeland Security states in its national vision that the "federal government will work to create an environment in which state, local, and private entities can best protect the infrastructure they control."[204] From this context, the applicability of UASs extends now to private operators.

a. Border Protection

UASs are well suited for border protection mission. Plans are currently underway to equip the Customs and Border Protection Service with their own fleet of UASs operating independently from the military. The military currently monitors air traffic activity along the United States-Mexico border through aerostats and manned aircraft, but interdiction of illegal activity is the mission of the Customs and Border Protection as a federal law enforcement agency. The border is a resource-thin environment, but to remedy this shortfall, President Bush, in 2005, advocated strengthening border protection by increasing the number of agents by 6,000. There is no substitute for "boots on the ground" border agents, but until such time that all of these agents can be recruited and trained, UASs can be used to increase the efficiency of the current force structure. If illegal activity is detected, agents can be dispatched to the area of concern much like a police officer in a city. This arrangement frees agents to occupy legal border crossing sites and known sites of illegal activity, thereby allowing a more efficient allocation of the limited number of Customs and Border Protection forces.

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[202] U.S. Customs and Border Protection, *Preventing the Entry of Terrorists and Their Weapons While Facilitating Legitimate Travel and Trade, September 2006.* http://nemo.cbp.gov/opa/blue_highres.ppt#303,13,Slide 13 (accessed 14 November 2006).

[203] Office of Homeland Security, *National Strategy for Homeland Security*, p.31.

[204] Ibid.

Predator systems are capable of carrying sensors for all weather, 24 hour, detection of illegal border activity but, to do this, the UAS would require mission-designated airspace to successfully operate. Once illegal activity is detected, tactical UASs like the Dragon Eye and Raven could be operated by a single Customs and Border Protection agent to enhance their local surveillance capabilities in a specific area. These systems operate below the floor of controlled airspace and need neither sense-and-avoid equipment on board nor dedicated airspace.

Operating UASs within the National Airspace System along the international border is less problematic than operations conducted in more internal regions of the continental U.S.. Civil air traffic along and across the border region is limited and that traffic is often more tightly regulated than operations conducted over more populated areas. Currently, the Federal Aviation Administration has established Temporary Flight Restrictions that prevent civil aircraft from entering the airspace along the border where UASs are operating. This type of arrangement however, represents only a temporary solution. The only viable long term solution to enableUAS employment on the border is the approval of unrestricted operations based on the certification of sense-and-avoid systems. To ensure maximum effectiveness of UAS border operations, the ability to operate on both sides of the border will be necessary. The Chicago Convention of 1947 defines the airspace above a nation as sovereign, as a result, international agreements need to be determined so UASs can legally operate in the sovereign airspace of Mexico or Canada.

Risks to civil liberties are also low since the majority of people being observed along the border are not U.S. citizens. Also, this type of surveillance operation is conducted by the U.S. Customs and Border Protection agency which has law enforcement authority.

b. Critical Infrastructure Protection

The *National Strategy for Homeland Security* divides critical infrastructure into 13 sectors; of those 13 sectors, UASs are immediately suited for use in protecting the defense industrial base, transportation, energy, shipping, and emergency services. While all these areas are considered to be critical national infrastructure,

shipping will be addressed in the subsequent maritime domain section and emergency services will be addressed in the civil support section.

The most potential for civil-military dilemmas exists in the use of UASs to serve in the protection of defense critical infrastructure. As was stated in Chapter 3, this responsibility falls not just to the installation commander where the infrastructure lies, but in instances where the military commander cannot protect the infrastructure because it is not contained within a military installation, civilian authorities carry significant responsibility. For example, the Houston ship channel is vital to national defense since approximately 80% of DoD petroleum resources pass through this one waterway.[205] In this example, UASs possess the capability to provide ISR and communication necessary to detect aggression and provide situation assessment and awareness for those required to respond. This mission set overlaps, on occasion, with the other critical infrastructure elements and, as was stated earlier, suggests that UASs could benefit operators other than the military or law enforcement agencies.

Transportation is a broad category that includes air, land, and rail systems. As the *National Strategy for Homeland Security* suggests, the maintenance of national commerce depends upon these industries. UASs, with their mobility, persistence and wide potential for monitoring are well suited for monitoring the physical properties of road and rail systems. The ability to position and reposition a UAS in minimal time is an attribute that is called for in this strategy document. "The national infrastructure protection plan will organize the complementary efforts of government and private institutions to raise security over the long term to levels appropriate to each target's vulnerability and criticality."[206] UASs offer the flexibility to be repositioned rapidly as needs dictate. This is a valuable capability when applied to expansive sector such as energy.

Energy is a large sector that is made up of electricity, oil, and natural gas. Each of these sectors has unique elements but common to all are production facilities, transportation and distributions systems. As with the previous sections in this chapter,

[205] Dr. Craig Hooper, Lecture at the Naval Postgraduate School, Monterey, Ca., September 2006.

[206] Office of Homeland Security, *National Strategy for Homeland Security*, p.31.

threat level and vulnerability is used to determine where physical protective measure need to be elevated. UASs can aid in protecting the transportation and distribution systems as a result of their surveillance capability. Most of the production facilities are in or near populated areas, however pipelines and electrical power lines transit expanses of unpopulated areas. Industry has electronic means of monitoring the health of their systems, but they also conduct physical assessments of their assets. Unmanned aerial systems are well suited for such missions. Flying over any stretch of the 160,000 miles of crude oil pipeline or the 278,000 miles of natural gas pipeline could easily fit into the "dull" mission as described in chapter I.[207] Regardless, the 2006 closure of the Alaskan Pipeline from the Prudo Bay oil field is a valid reminder of the impact reduced oil flow can have on the U.S. economy.

The electrical power grid is another system that has national implications if it is disrupted. This system is made up of power generating and power distribution systems. The distribution system is made up of a network that shifts electrical power to areas of the country to meet varying levels of demand. The system is spread over the continental U.S. and is vulnerable in many locations and in addition to the ability to reroute the flow of power in case of a distribution interruption, UASs could provide local surveillance of a physical asset that has national implications.

The main obstacle to conducting such operations over the land domain is the sense-and-avoid ability required to operate in the airspace above these assets. Until such a time that UASs can freely operate within the National Airspace System, their capabilities will go unused. Only when the threat and vulnerability conditions dictate will airspace restriction likely be put into place for their use.

Once sense-and-avoid capability is certified and restrictions no longer exist, the most appropriate agencies to conduct such missions are a combination of Title 32 military, state and local governments, and industry representatives. These agencies are not affected by the Posse Comitatus Act and are most familiar with normal conditions

[207] Office of Homeland Security, *The National Strategy for the Physical Protection of Critical Infrastructures and Key Assets*, Washington D.C.:Government Printing Office, 2003. p.52. http://www.whitehouse.gov/pcipb/physical.html (accessed 14 Nov 2006).

and operation of local critical assets. Including all of these agencies in UAS operations conforms to the national vision stated earlier in this section.

The UASs best suited for these missions include mini UASs for specific locations such as electrical power production stations or refineries. Small tactical UASs that can provide surveillance beyond local areas are appropriate for patrolling pipeline and electrical power line segments. Larger tactical systems like Predator can provide persistent coverage over key assets such as bridges or nuclear power plants or be used for patrolling larger expanses of pipeline and electrical power lines.

The risk to civil liberties are low for this mission set as well, since the military is performing an authorized mission, focused on protecting physical assets, and other private operators cannot use the information they collect against U.S. persons.

3. Maritime Defense

UASs are applicable and perhaps best suited for the maritime domain awareness mission. The main consideration behind this statement is the vast expanse of the ocean. Defense of the American homeland may at first seem to be only concerned with the waters near the United States. In actuality, national commerce is dependent on the international trade made possible via the shipping industry. The layers of protection become more integrated with closer proximity to the homeland. However, deterring and detecting threats as from the homeland as possible, in accordance with the *National Strategy for Homeland Security,* is more likely with the employment of UASs.

Satellites are well suited to surveil the great distances of the open ocean but their capabilities are limited. Since satellites travel at great speed they can cover large surveillance areas, but as a result they cannot provide persistent surveillance of a target once detected. At the other end of the spectrum is the surveillance capabilities provided by surface ships. Mini and rotary wing UAVS can be employed from ships with minimal deck space enabling almost any ship to carry a UAS and increase their surveillance capabilities. Regardless of the combination of ship based UASs and shipboard surveillance systems, surveillance coverage area is localized when compared to satellites. High attitude, long endurance systems can fill the gap between these two extremes.

The Global Hawk provides the surveillance area capability required for the maritime domain. The aerial vehicle itself has tremendous endurance and demonstrated its ability to conquer great distances. In 2001, it flew non-stop over the Pacific to Australia some 7,500 miles away.[208] The Global Hawk's sensor package is also appropriate to the maritime environment. It carries synthetic aperture radar, infrared, and electro-optical sensors for all weather, day and night capability. When equipped with a ground moving target indicator, staying on target becomes even more likely. UASs like the Global Hawk provide a layer between the surface and space and strengthens the overall maritime defense layer. As a result the risk to the shipping industry, which is critical to national commerce, is also lowered.

Most of the legal restrictions present in the air and land domains are not present in the maritime domain. The operational restrictions that exist within the national airspace system over the continental U.S. do not exist over the open water. The U.S. Coast Guard is a law enforcement agency and as such is not subject to the restrictions of the Posse Comitatus Act. The U.S. Navy is acting in its defense role and has no Posse Comitatus Act limitations outside the United States. Issues of privacy and surveillance are not contentious with this mission set since area surveillance is the objective, not personal or individual surveillance. Lastly, sharing of information is not restricted between these two organizations like the restrictions imposed between law enforcement and intelligence agencies.

4. Civil Support

Emergency services can benefit from UASs and Hurricane Katrina served as an example of the value UASs could provide after a widespread disaster. Providing voice and internet communications for rescue teams immediately following the disaster are extremely valuable for coordinating a government wide response if local infrastructure is damaged or destroyed. Area surveillance with image distribution via the internet is another capability that could enhance a recovery effort through rapid documentation of the scope of damage.

[208] Department of the Air Force. "Global Hawk."

The multiple sensor packages available for UAS platforms can aid in search and rescue. Assigning the search mission to a UAS will allow manned aircraft to concentrate on the rescue part of search and rescue. Day and night sensors mean continuous search capability without crew fatigue concerns.

Before Hurricane Katrina, FAA approval of UAS operations requests was measured in weeks, but improvements in the bureaucratic process have all but eliminated the delay. In July 2006, the FAA and the DoD established a new procedure to streamline the approval process for using UASs over disaster areas. In less than 6 hours, military UASs can be flying over the designated area under the control of the lead federal agency. This initial agreement is for Predator B systems only but could expand in the future. Predator Bs are projected to be used in intermediate altitudes above rescue forces and logistical support aircraft. Current sense-and-avoid technology deficiencies require the UAV to be followed by a chase aircraft until it is on station and within the confines of protected airspace above the disaster area. When technology produces an adequate sense-and-avoid capability, UASs will be able to "file and fly" directly to their assigned target area without chase aircraft. Other regulatory arrangements are required for the wide array of potentially useful unmanned aerial systems.

In cases of disaster relief, non-DoD agencies are typically designated as lead federal agencies, so Posse Comitatus and concerns about surveillance of individuals are negated. In the case of a terrorist attack, use of the military to protect the U.S. is the primary responsibility of the President and the military. In such cases, the military is within its legal authority to use all of its resources. UASs are applicable to civil support missions and as UAS capability increases, only the imagination will be the limit for UAS applications.

B. INFORMATION SHARING

The element of UAS success that recurs throughout this document is the ability of these systems to disseminate data. Chapter III described the federal government policy evolution from early disaster response to current disaster/defense response. The dominant factor that forced policy evolution was the demand for timeliness of the response based on the capabilities and characteristics of society in that era. In the early 19th century, Congressional action weeks after an event might have been seen as speedy.

Contemporary requirements for an increasingly urbanized America dictate same day response. As a result, UASs are a natural fit for a society hungry for immediate information exchange.

In regards to Homeland Security, the *National Strategy for Homeland Security* relies on the participation of all government agencies, from the local first responders to high federal authority to execute an effective defense. Since an asymmetrical attack, characteristic of 9/11, can originate almost anywhere, the ability to provide situational awareness data for those required to respond is extremely valuable. The military and federal government have undergone historic reorganization primarily to coordinate the efforts of the numerous agencies involved. In order to take advantage of the full spectrum of response capabilities, establishing and maintaining a communications interface capability from local officials to the highest level of government is imperative.

The Global Information Grid is a system that will connect all government information systems for access by appropriate agencies. Theoretically the battlefield commander would be able to see what the infantryman sees in his gun sight, what the pilot sees through his heads up display, and what the UAS is seeing. With such a complete picture of the battle sphere, commanders will be better equipped to effectively prosecute the battle. The same concept applies to homeland defense with the lead federal agency having access to the information from the local emergency response authorities, law enforcement and the military. The GIG is in its evolutionary infancy and only time will tell if its designed intent will be realized

In instances where sharing information might be of concern for privacy or national security reasons, distribution of UAS surveillance information can be accessed through internet-based distribution systems. One possible solution is for the agency controlling the UAS to publish data it collects to a server where access to the data can be controlled. This arrangement allows for compliance with legal consideration for law enforcement and intelligence agencies and security clearance considerations between agencies with and without security clearances. Ultimately, leveraging the power of a network based distribution and communications system will ensure information requirements are legally transacted when required.

C. CONCLUSION AND RECOMMENDATIONS

Rapidly advancing technology is increasing UAS capability and widening their range of applications. Extensive combat operations have propelled UAS development and made the military owner of the preponderance of UAS assets. However, the *National Strategy for Homeland Security* dictates an inclusive, "national" effort rather than solely a federalized, military-led effort. To realize the intent of that strategy, agencies beyond the Title 10 military should take primary lead in the domestic employment of UASs; active-duty military forces are not the only entities capable of operating UASs. Title 32, law enforcement, and private industry should lead UAS homeland defense efforts, and Title 10 forces, strained by five years of war can continue their job of fighting the nation's wars undistracted.

State militias are integrated into the active forces for wartime operations, but when they are not placed in this capacity they are under the command of their state governors. As a result, the Posse Comitatus restrictions do not apply to them. This allows Title 32 state forces to respond in a lead role, unlike Title 10 forces that are required to operate in subordinate roles domestically. Assigning tactical and high altitude/long endurance UASs to Title 32 military forces allows for domestic employment of these assets while still maintaining a combat capable force to integrate with Title 10 forces when required.

The Customs and Border Protection Service is well suited to operate UASs in the protection of U.S. international borders. Since no military specific training is required for their operation, only funding constraints will limit their employment capabilities. Airspace restrictions and international agreements are currently hindrances, but do not seem to be insurmountable obstacles in this mission area.

First response and law enforcement agencies around the country utilize manned aircraft daily. The addition of unmanned aerial systems to their arsenal has advantages on both tactical and strategic levels. A tactical level benefit is determining the scale of incidents and determining the resources needed to respond. The 9/11 attack on the World Trade Center towers is an example of how a locally operated UAS could have been used to help experts assess the physical damage. A strategic level benefit in this example

would have been the single point of reference for imagery. Such an arrangement could have meant the dissemination of the evacuation order to both the police and fire departments. Sadly, only the police department received an evacuation order on that day.

Congress has fully funded UAS development requests over the last ten years and continues to aggressively fund them for the DoD and DHS. The Department of Homeland Security administers a grant program for state requests. This would be a viable mechanism for state law enforcement agencies to acquire unmanned aerial systems.

This analysis indicates that the technological capabilities of unmanned aerial systems meet intelligence, surveillance, and reconnaissance technical requirements, satisfy current homeland defense mission requirements, and can be operated by Title 10 military forces or others with minimal legal restrictions. The Posse Comitatus Act does not overly restrict the active military from responding to national crises and current DoD directives offer satisfactory guidance describing when military assistance to civil authorities is appropriate and how to provide it.

A short term solution to national security concerns may require the active military to answer requests for domestic UAS employment. However, the long term solution, in accordance with the published national strategy, is to engage in a national effort and leverage the capabilities of all levels of government, industry, and private citizens.

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