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OUT OF SYNCH:

JOINT SOLUTIONS FOR UNMANNED AERIAL SYSTEMS

by

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A Research Report Submitted to the Faculty

In Partial Fulfillment of the Graduation Requirements

15 February 2008

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BIOGRAPHY

COL John Dowd entered the United States Army from Bellport, New York, and graduated from the United States Military Academy at West Point in 1984. He was commissioned as an Army Aviation Officer and attended the Aviation Basic Course. In 1985, he graduated from the Army Aviation Rotary Wing Course and was assigned to Fort Lewis, Washington in the 9th Infantry Division, where he served in a variety of junior leader positions, including company command. Following attendance at the Aviation Advanced Course in 1991, COL Dowd earned a degree at Harvard University in preparation for assignment as an Assistant Professor at the United States Military Academy from 1993 to 1995. After attendance at the Command and General Staff College at Fort Leavenworth, he was assigned to the 1st Armored Division at Hanau, Germany where he served in several field grade positions, including both battalion and brigade executive officer positions. While assigned to Germany, COL Dowd deployed in support of operations in both Bosnia and Kosovo. Upon return from Germany in 2001, COL Dowd served on the National Airborne Operations Center (NAOC) at Offutt Air Force Base, Nebraska. In 2003, he took command of 1st Battalion, 212th Aviation Regiment, a training battalion responsible for primary and advanced flight training at Fort Rucker, Alabama. Following battalion command, from 1995 to 1997 COL Dowd served as the Chief, Organization and Force Development Branch of the Directorate of Combat Developments in the Army Aviation Warfighting Center at Fort Rucker. He is presently assigned to the Air War College at Maxwell Air Force Base, Alabama. COL Dowd is married to the former Donna Uzzo of Rocky Point, NY and they reside in Dothan, Alabama with their ten children. COL Dowd has earned the Senior Aviator Badge, the Parachutist Badge, and the Air Assault Badge. He is qualified in the AH-64 Apache, AH-1 Cobra, UH-1 Huey, and OH-58 Kiowa aircraft.

INTRODUCTION

Commanders often wrestle with finding the appropriate balance between efficiency and effectiveness. While it is always best to expend as little as possible to execute a mission, there is some risk in seeking the most efficient solution. Sometimes "just enough" will be too close to "not enough" for a commander's comfort. The Air Force, for good historical and operational reasons, has always placed a premium on efficiency. Operating expensive, complex, and scarce assets and often delivering strategic weaponry, the Air Force perspective emphasizes the high costs of "wasting" efforts against low priority targets. The Air Force mantra of "centralized management, decentralized execution"[1] is designed to ensure that operations are as efficient as possible. The Army, however, sees things differently. With a culture deeply influenced by tactical operations, the Army values effectiveness over efficiency.[2] In a pitched battle, filled with fog and friction, the difference between winning and losing might be the presence of one key asset. The Army mindset is to ensure the presence of that key asset, even if it will not be used in every battle. The Air Force would argue that this asset is wasted and ought to be employed somewhere on the battlefield where it is needed.[3] Of course, these characterizations are overly broad and generalized, but they do give a sense of the tension between the Air Force and Army over unmanned aerial systems (UAS)[4], a tension that has manifested itself in the Air Force's recent efforts to obtain Executive Agency over all medium to high altitude UAS. Any proposed joint solution for UAS will have to somehow accommodate this tension.

The Air Force recently provided an important service when, by seeking Executive Agency (EA) for all medium to high altitude UAS, it pointed out that DOD does not have a coherent strategy for dealing with the proliferation of service UAS and the resulting pressure on traditional airspace control measures. What are the roles and missions of these UAS from a joint

perspective? What joint doctrine covers their employment in a multi-service environment? What interoperability standards for communications, data transfer, bandwidth utilization, aircraft identification, payloads and armament are being enforced? How are airspace command and control procedures being adjusted in response to the growing dependence on UAS?[5] By seeking EA the Air Force highlighted that the existing organizations and mechanisms for answering these questions are not working. The truth is that no existing agency has the power to enforce standards on the UAS community. Unfortunately, the Air Force message has been lost amidst the perception, fair or unfair, that the Air Force bid for EA was simply a thinly disguised power grab for other services' assets (after all, the Army had been operating the Hunter UAS at altitudes up to 25,000 feet for years, without serious objections from the Air Force).[6] But if the Air Force is not the right choice for pursuing "jointness" for UAS, then some organization must be given the mandate—and the authority—to produce it. The thesis of this paper is that, as a minimum, DOD must develop more effective means of: a) overseeing and influencing service UAS programs; b) developing joint doctrine; and c) adjusting airspace command and control methods to accommodate UAS. Further, DOD's recent decision to "merge" the Air Force's Predator and the Army's Sky Warrior provides an excellent opportunity to make progress in each of these areas.

BACKGROUND

Innovators have been interested in unmanned aircraft since the early days of flight. In 1896, Dr. Samuel Langley launched a steam-powered aircraft over the Potomac River to demonstrate the possibilities of flight; the vehicle was unmanned as Dr. Langley, though confident in his theories, was not inclined to personally test them.[7] Interest in unmanned flight

waxed and waned in the ensuing years, but did not get serious attention until the Vietnam War and even then UAV employment was restricted to minor supporting roles. It was Israel's extremely successful use of armed UAVs during the 1973 Yom Kippur and 1982 Lebanon actions that caught American military attention. The Navy acquired an Israeli platform, the Pioneer, and used it effectively during Desert Storm. This success led to the Air Force's acquisition of the experimental Predator, which saw action in Bosnia and Kosovo. During the 1990s, DOD was content to allow the services to develop their own UAVs, each tailored to specific domains and missions.[8] As long as these platforms were restricted to Intelligence, Surveillance, and Reconnaissance (ISR) missions, no service perceived a threat from another's program. Things changed in 2001 when a Predator test-fired a Hellfire missile, creating the potential for the "hunter" to also become the "killer."[9] The demonstration of an armed UAV created great interest in the other services and especially in the Army, for which its Military Intelligence branch had been operating ISR-focused UAS for years with little fanfare. The Air Force test came at a time when Army leaders were transforming their forces to lighter, leaner force packages and were looking for innovative ways to lighten forces without giving up significant firepower. An armed UAS was on attractive solution and the Army began the process of acquiring the Warrior, an armed UA that, as it turned out, would look and act very much like the Air Force Predator. The Air Force could accept other services possessing their own reconnaissance platforms, but an armed UA seemed very much like a close air support platform, usurping a role that the Air Force had zealously defended since the 1960s.[10] A struggle between the Air Force and Army was clearly on the horizon.

Though similar in some ways and manufactured by the same company, there are significant differences between the Air Force Predator and the Army Warrior. The Warrior is

slightly larger, carries four Hellfires (versus two for the Predator), and burns JP-8, the same fuel the Army uses for its helicopters and ground vehicles. The Warrior will be flown in theater by enlisted Soldiers who will answer to a ground commander, whereas Predators are operated under the "reach-back" concept: launched and landed by personnel in theater but controlled during missions via satellite by rated pilots in Nevada. The Warrior will be controlled by a mobile Common Ground Station that will be capable of controlling all Army UAs. The Predator provides video feeds to the Remote Operations Video-Enhanced Receiver (ROVER), while the Warrior will send its feeds to a ROVER-variant that will provide the operator with advanced mapping and position location capabilities.[11] Though their service ceilings are slightly different, they both exceed 3500 feet, the altitude above which the Air Force sought Executive Agency for all DOD UAS.

Most Air Force UAS are dedicated to ISR missions. The Air Force sees medium and high altitude UAS as strategic assets that accomplish important strategic ISR missions. In a typical theater, there will be many more requests for ISR support than there are assets to service them. [12] The Air Force will seek to prioritize the missions and apply available means (UAV, overhead reconnaissance, manned aircraft) against only the most important of these missions. In other words they will seek to centrally manage an efficient solution to the problem of too many requests for available assets: "DOD cannot afford the inefficiencies that result from individual service UAV stovepipes."[13] In contrast, the Army sees the UAV as simply another combat multiplier that, depending on echelon, can accomplish a number of key tasks: kinetic strike, reconnaissance, and communications support being three primary ones. Lessons learned from Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) dictate that they be assigned organically at division levels and below; experience has shown that while UAS may not

be critical to every mission, to be effective when absolutely needed they must be at the commander's immediate disposal. The problem arises when there is an asset that appears to straddle both sets of service missions. The Air Force's MQ-1 Predator and the Army's forthcoming Warrior have similar capabilities and could accomplish missions for either service. The approaching fielding of the Army's Warrior was a significant impetus to the Air Force seeking Executive Agency for all mid to high altitude UAS.

THE AIR FORCE AND EXECUTIVE AGENCY

In September 2007, Defense Undersecretary England signed a document that effectively rejected an Air Force bid for Executive Agency of all UAS that fly above 3500 feet. In the spring of 2007, Air Force Chief of Staff General Mosely had written a memo seeking Executive Agency over all such systems, arguing that efficiency and safety concerns made such a move necessary.[14] During operations in support of OEF and OIF, employing both the airliner-sized Global Hawk for strategic collection and the smaller Predator for strategic and tactical operations, the Air Force developed significant experience with UAS. They have watched with concern as theater airspace has become crowded by a variety of airborne vehicles, including UAS operated by other services. For example, the Army now operates the Raven UAS, a company-level asset that operates as high as 1000 feet, and the Shadow UAS, a battalion/brigade-level asset that operates up to 15,000 feet.[15] Most significantly, the Army will soon field the Warrior UAS, which, as noted above, will be capable of carrying armament, ISR or communications relay payloads at altitudes up to 25,000 feet. This UAS appears capable of intruding into Air Force controlled airspace and traditional Air Force roles and missions. If the Air Force request for Executive Agency had been approved, they might have assumed

responsibility for the design, acquisition, and fielding of the Army's Warrior and might even have assumed operational control of the fielded assets. This explains the Army's vociferous opposition to the Air Force proposal.[16]

What is executive agency? According to a 2002 DOD directive, it is "the Head of a DoD Component to whom the Secretary of Defense or the Deputy Secretary of Defense has assigned specific responsibilities, functions, and authorities to provide defined levels of support for operational missions, or administrative or other designated activities that involve two or more of the DoD Components."[17] The directive goes on to specify that Executive Agency is only to be used when no other existing agency exists to execute the assigned duties. The duties to be executed by the designated Component are not spelled out in the directive, and, in fact, "the nature and scope of the DoD Executive Agent's responsibilities, functions, and authorities shall…be prescribed at the time of assignment."[18] The Army was concerned that, after receiving Executive Agency, the Air Force would almost certainly cancel the Warrior program and direct that Army UAS needs would be supported through a centrally-managed, Air Force-controlled fleet, similar to how Close Air Support (CAS) is provided.[19]

The Air Force has good reasons for seeking a single responsible agency for UAS, especially for those that operate at the same altitudes as their manned aircraft. Since World War II, in North Africa at battles such as Kasserine Pass, when aircraft were "piece-mealed" or distributed among ground commanders without regard to where on the battlefield they might be most effective, the Air Force has stressed the importance of centrally managing scare air power assets.[20] Air Force leaders would fully endorse General Eisenhower's comments about the resulting solution to the Kasserine debacle: the reorganization of air assets must ignore "the competing demands of individual commanders on a far-flung battlefront, each of whom would

naturally like to have at his disposal some segment of the Air Force for his own exclusive use."[21] The Air Force sees the Army's plan to dedicate Warriors to ground commanders as a repeat of this kind of mistake: "one division might hoard its UAVs while another division had a greater need for that capability. Under JFACC control, commanders are able to better shift around the assets to meet combat needs."[22] They would prefer to centrally manage these assets, prioritizing them in areas that truly need them and withholding them from areas that do not. As it currently stands, the Air Force has more ISR requirements than it has assets to service them. The prospect of the Army's Warriors, as or more capable than the Predator, sitting idle while intelligence collection requirements go unserviced is hard for the Air Force to tolerate. One analyst points out that an Air Force- managed fleet could produce approximately 85 percent availability rates in a given theater, whereas the Army, by tying these assets to specific units, would have only those Warriors deployed to theater, which might represent about 35 percent of the total fleet.[23] The Air Force has also noted that the traditional means of separating Army from Air Force air traffic, a coordinating altitude set at an appropriate ceiling, has been blurred by the proliferation of Army UAS. Unconfirmed reports of collisions and near-collisions of manned and unmanned vehicles in theater further highlight Air Force concerns. The inability to positively identify, track, and control all vehicles in the airspace for which the Joint Force Air Component Commander (JFACC) is traditionally responsible underscores the Air Force perception that more centralized control of medium and high altitude UAS is required.[24]

The Army has compelling reasons for insisting on retention of the Warrior and future UAS. Over time, the Army has come to believe that it cannot always depend on critical support from outside agencies. In the 1970's, the Army fought to keep its armed helicopters to complement Air Force CAS, support that is not always available from centralized Air Force

assets due to high mission demands.[25] Despite tremendous progress made in developing "jointness," Army leaders continue to be skeptical about the Air Force's ability to consistently provide CAS at the exact time and place they need it. In 2002, 10th Mountain Division Commander MG Franklin Hagenbeck "started an interservice debate over his contention that close air support (CAS) was unresponsive during Operation Anaconda in Afghanistan."[26] 3rd Infantry Division leaders also had complaints about CAS support during operations in Iraq.[27] Concerns about CAS support are not simply a reflection of interservice in-fighting: in 2003 the General Accounting Office (GAO) issued a report critical of the state of joint CAS.[28] Army leaders understand the need for and benefits of the Air Force's Air Tasking Order (ATO) cycle, but effective as it is for efficiently managing air sorties, one of its very real drawbacks is its inflexibility and inability to quickly respond to the actions of a thinking, uncooperative enemy. Just one recent example was the launch of Operation Iraqi Freedom when, because of changing circumstances, the schedule for attack was moved up but "the Air Tasking Order was simply not flexible enough for a full-scale, all-out attack on Baghdad to take place that night."[29] All of this is not to place all the blame for the inadequacies of CAS on the Air Force. In a world of complex missions and limited resources, the Air Force must always prioritize its scarce assets. However, in the face of this reality, the Army's desire for its own organic UAS "insurance policy" is understandable.

The Army is transforming to a "modular force," which includes brigade-sized packages that include all support required to immediately execute ground operations. The Brigade Combat Team (BCT) will have tactical UAS organically assigned (Raven and Shadow) and Warriors will be organic to aviation units in direct support. Always more concerned with ensuring timely support to the commander than with overall efficiency, the Army believes that

these assets must be in the immediate vicinity of the ground commander. One Air Force general inadvertently made the Army point in defending the Air Force's desire to centrally manage all Predator and Predator-type UAS: "Any particular small unit might only need the ability for a certain number of minutes [of coverage] out of every hour…"[30] The Army believes that only organic possession of the asset will absolutely ensure the "ability" is available during that "certain number of minutes." If an out-of-contact commander's UAS are sometimes out of the fight, this is an acceptable price to pay for a variety of reasons that will be explained below. Into the future, the Army sees UAS technology less as a specialized asset that provides support on special occasions and more as a normal part of the force, no more exotic or unusual than a SATCOM radio, laser designator, or crew-served weapon. Brand new technology is always too expensive, too untested, and too complex to be dispersed throughout the force. However, over time, some technology becomes cheap, reliable, and simple enough to be pushed to much lower levels than originally conceived.[31] The Army sees UAS technology this way. In fact, for the Army's Future Combat Systems (FCS), a system of combat vehicles scheduled to reach Initial Operating Capability (IOC) in 2014, UAS will be thoroughly integrated from the initial design phases through completion. In other words, the FCS will be incomplete without UAS.[32] Finally, with regards to Air Force concerns about safety, the Army asserts that there have been no documented accidents or incidents between Air Force manned aircraft and Army UAS.[33] There are also significant on-going Army-Air Force efforts to improve the congested airspace problem, several of which will be discussed below.

Much of the popular and even defense media have painted this struggle as being exclusively about the Army's Warrior UAS because it so closely matches an existing Air Force asset. A thorough review of recent news accounts yields no Air Force references to other

existing and developing Army UAS that are capable of exceeding the 3500 foot standard. But Air Force leadership clearly understands that the problem is much larger than an inter-service squabble over rival programs. In a recent four-star conference, the Air Force Chief of Staff highlighted concerns about joint doctrine, acquisition, and safety. All service leaders recognize that the proliferation of UAS has produced real problems that are not going to get better without focused attention.[34] Unfortunately, these leaders cannot agree about the best way to provide this oversight. Again, due to its traditional role as theater airspace manager and its experience operating strategic ISR platforms, the Air Force sees itself as the natural choice for providing overall direction and management of the DOD UAS community. The Army contends that existing joint organizations are adequate to provide the necessary oversight. The Navy and Marine Corps have quietly supported the Army's position, arguing that, because of the unique demands of the domain from which they operate, only they can develop and field appropriate systems.[35] Again, the Air Force's request for EA has been rejected. But the issues that gave rise to their attempt remain problematic and, for reasons discussed below, are unlikely to be solved by the joint organizations as they are currently configured. The Defense Department lacks coherent joint strategies for a) acquiring whole families of UAS that should be interoperable, complementary, and not stove-piped by the service acquisition systems; b) developing joint doctrine for UAS so supporting roles and missions of service UAS are well-understood and integrated across DOD; and c) modernizing airspace control and deconfliction to make sense of increasingly crowded airspace. The following examinations of these areas will yield proposals for improvement in each.

JOINT UAS ACQUISITION

A joint acquisition plan for UAS would provide comprehensive, detailed guidance for how and where service UAS acquisition efforts will both fill service needs and fit into an overarching joint philosophy. However, a variety of oversight efforts have concluded that the Department of Defense lacks just such an acquisition plan. Typical is the following, taken from a 2005 Government Accounting Office (GAO) report: "Although DOD guidance requires interoperability, detailed standards for interoperability have not been developed; DOD has relied on existing, more general standards; and the services developed differing systems."[36] To be sure, there are joint publications with promising titles: "Unmanned Aerial Vehicles and Uninhabited Combat Aerial Vehicles" from the Defense Science Board in 2004 and "Unmanned Aerial Vehicles Roadmap 2005-2030" from the Office of the Secretary of Defense in 2005, to name just two. But upon closer inspection each turns out to be little more than descriptions and discussions of existing service UAS platforms, some of which have long been underway without the benefit of any joint guidance. Each document notes the lack of joint interoperability identified in the GAO Report, but seems to rely upon the voluntary cooperation of acquiring services to conform to recommended interoperability standards. For example, DOD's Joint Concept of Operations document acknowledges that, though joint standards exist, the "JUAS COE [Joint Unmanned Aerial Systems Center of Excellence] will leverage existing Service initiatives to provide joint integrated solutions and improved interoperability."[37] One major problem is that there is no overarching entity that has the teeth to force existing programs to reengineer or to compel managers of developing systems to adhere to proposed standards, especially when fiscal or time constraints force tough choices. Longtime observers of service

acquisition programs know that when program managers must face tough choices, interoperability is often a casualty.

There is a confusing array of entities that are responsible for overseeing the acquisition of UAS. First, in order to ensure that service-initiated programs are reviewed and potentially adjusted to ensure "jointness," DOD established the Joint Requirements Oversight Council in the wake of the 1986 Goldwater-Nichols Reorganization Act. This Council, chaired by the Vice Chairman of the JCS, reviews all major weapons systems proposals to ensure that none becomes stove-piped and that each is as interoperable as possible. To further improve and assist the Council, in 2003 DOD established the Joint Capabilities Integration and Development System (JCIDS). This system was designed to shift the focus from service-specific capabilities shortfalls to those truly needed and requested by combatant and regional commanders.[38] Recognizing the complexity and potentially uncontrolled proliferation of UAS, in 2005 the JROC added the Joint Unmanned Aerial System Center of Excellence (JUAS COE) and the JUAS Material Review Board (JUAS MRB). The COE is designed to facilitate "the development and integration of common unmanned aircraft system operating standards, capabilities, concepts, technologies, doctrine, tactics, techniques, procedures and training."[39] But, the COE also "leverages existing Service initiatives and activities to provide joint integrated solutions and improved interoperability."[40] In other words, though a joint agency will direct interoperability to occur, it is going to rely on what the services are already doing to produce it. An additional layer is the Material Review Board, yet another entity which provides "a forum to identify or resolve requirements and corresponding material issues [to promote] interoperability and commonality [and to] prioritize potential solutions."[41] In September, Undersecretary England directed that yet another entity be created, "a task force under the Pentagon's acquisition chief be set up to

'coordinate critical UAS issues and to develop a way ahead' on the systems."[42] The bottom line is that, though the DOD acquisition leaders have identified interoperability as a key consideration and have developed several overlapping organizations to produce it, in reality it is currently unable to force it onto the UAS community. Typically, these organizations, made up of service representatives, tend to "rubber-stamp" service acquisition requests, knowing that a culture of *pro forma* approvals will give their own services' programs better chances for survival.[43] These organizations have no real teeth or incentives to make the hard choices to force integration of programs or at least the adoption of firm interoperability standards. Ironically, the one recent joint success story—the Marine Corps' decisions to adopt both the Army's Raven and Shadow systems as replacements for their own aging platforms—resulted not from any directives from above, but instead came from the Marine Corps' own internal analysis.[44] Clearly, if similar systems are to be more common, some organization with real authority must be able to direct interoperability, especially in the areas discussed below.

Bandwidth has arguably become one of the most precious resources in theater. On the modern battlefield, demands for bandwidth far exceed available capacity. For example, "Global Hawk consumes five times the total bandwidth used by the entire military in the Gulf (Desert Storm)"[45]. Without an overall acquisition strategy that coordinates UAS bandwidth usage, DOD finds itself in the situation where UAS in theater are sometimes grounded, not by weather or maintenance, but by a lack of available bandwidth. Exacerbating the problem is the presence of UAS that are extremely limited in the frequencies or portions of the available bandwidth they can utilize, forcing overcrowding of this scare resource.[46] Individual services have recognized and are grappling with this problem. Recently, Air Force Lieutenant General Donald Hoffman, a senior officer in the Air Force acquisition office, stated that the Air Force "is seeking companies

that can reduce bandwidth requirements for UAVs."[47] He argued that UAS need to utilize non-traditional portions of the electromagnetic spectrum, such as the Ka- and L-band channels. This is the right direction, but without a strategy that encompasses how all available bandwidth will be distributed across service platforms, new bandwidth will be quickly overcome by the same problem: too many users needing more and more capacity. An overarching DOD acquisition strategy could focus services on particular parts of the bandwidth spectrum or, even better, could direct that service UAS have the ability to use the entire breadth of traditional and non-traditional bands would allow the dynamic bandwidth management that will be required in the future.

Though the Warrior and Predator UAS are similar in some aspects, one of the most striking differences is in how they are remotely operated. The Army developed a GCS that is capable of controlling all existing and projected Army UAS, but as presently designed, is capable only of in-theater control, typically within line-of-sight communications. This is markedly different from the Air Force approach, which launches the Predator locally in theater, but then hands it off to pilots in the continental United States (CONUS) via satellite communications. Ideally, the Warrior and Predator would be controlled by both methods, but without some DOD guidance this will not happen. As it stands, the Air Force is not interested in having its aircraft flown by non-rated Army Soldiers, while the Army resists the idea of being supported by anonymous pilots from afar, even though it is easy to foresee circumstances where either of these scenarios might be the best option for the commander. Imagine a situation where an Army operator, under fire and forced to relocate, temporarily hands off a UA to an Air Force pilot until the original operator is able to reorganize in another location. Conversely, imagine a situation wherein a CONUS-based Air Force pilot transfers a Predator to an in-theater operator who, being closer to the ground commander, can better understand and implement that commander's intent.

Neither of these realistic scenarios will be possible because these programs fall short of full interoperability. Though, as noted above, Undersecretary England did direct these Air Force and Army programs to be combined, it is unclear whether this "combination" will extend to the methods of control.

Better progress has been made in terms of payloads and armament. Both the Predator and the Warrior will be capable of firing the Hellfire and, potentially, the Viper Strike, a gliding, laser-guided munition that will produce less collateral damage than the Hellfire.[48] They will also both carry the same Multi-Spectral Targeting System (MTS), which allows for day and night observation and laser targeting, and the Synthetic Aperture Radar (SAR) with Ground Moving Target Indication (GMTI) capability to spot moving targets. However, these examples of interoperability occurred by chance and not because some DOD agency directed them to happen. The fact that the Army's contract for the Warrior went to the same company that manufactures the Air Force Predator is more responsible for this interoperability than is any planning from above. The truth is that, absent a coherent DOD-wide UAS acquisition strategy, interoperability standards will not be developed or universally applied. This lack of interoperability will make it very difficult to produce joint doctrine, the subject of the next section.

JOINT UAS DOCTRINE

Related to the inability to enforce interoperability in any meaningful sense is the lack of a mature plan to produce joint doctrine for UAS. Existing doctrine is woefully outdated: Joint Publication 3-55.1, *Joint Tactics, Techniques, and Procedures for Unmanned Aerial Vehicles* was published in 1993, reflects the services' doctrine rather than providing a joint vision, and treats all UAS as tactical assets. This document has fallen far behind the capabilities and

limitations of the modern UAS fleet and, worst, specifically discourages the possibility of joint operations for UAS assets: "However, UAV units are only designed to support a single command or component. When UAV units are tasked to support more than one command or Service component simultaneously, degradation of effectiveness can result."[49] Other joint publications that discuss employment of UAS have similar drawbacks. Even a recent publication by the Air Land Sea Center focuses strictly on the tactical employment of service UAS, ignoring the operational and strategic applications and the joint doctrine that might apply to full spectrum UAS operations.[50]

Doctrine and acquisition have a symbiotic relationship: it is hard to determine which comes first, the end item or the doctrine governing its use. If a weapon represents a radical step forward, existing doctrine may have to be adjusted to accommodate new and innovative capabilities. On the other hand, as doctrine evolves it sometimes reveals a needed capability, forcing the services to improve an existing end item or produce an entirely new one. In reality, it is an iterative process that transfers advancements between the two and requires top-down guidance to ensure adherence to a plan. Compounding the problem for jointness is the fact that, as noted above, systems are acquired by services and justified by service doctrine. For joint UAS, the problem is the lack of a coherent acquisition plan that can guarantee interoperability of data transfer, communications, payloads and bandwidth utilization. Without it, it is hard for doctrine writers to produce even the outline of a tangible joint doctrine. Instead they will be confronted by a bewildering array of incompatible systems that make sense in terms of specific service doctrines, but would not necessarily fit into a larger "nested" plan.

The predecessor of any mature, detailed doctrine is a Concept of Operations or CONOPS. This provides the broad outlines of how a current or projected force might employ capabilities,

which can later be refined into more detailed and more authoritative doctrine. A review of the JUAS CONOPS suggests that, though impressively detailed, it is largely derivative of service operations and does not truly represent an overarching joint concept into which the service assets naturally fall. A 2007 GAO Report comments "that DOD has various processes related to UAS but note that none…represent a standardized, DOD-wide approach that the services and combatant commanders can follow in coordinating the specific details of deploying UAS assets, regardless of geographic area."[51] In other words, combatant commanders are left to the mercies of whatever equipment and associated doctrine the services bring to the fight, without regard to joint doctrine that could guide an overall theater plan. The current Joint UAS CONOPS document mainly codifies existing service-driven requirements and the systems that fulfill them. It groups existing systems into Joint UAS categories, but does not clearly explain how existing or projected systems could or should meet overarching joint requirements. Some discussion of potential cross-leveling of service UAS is discussed, but in general the document is service-centric. This suggests that the document is simply a *post hoc* attempt to knit together well-established service programs, an illogical process that delays development of joint guidance into the wake of service-led progress. To be truly effective, joint doctrine should begin with truly joint goals, purposes, and objectives that can be understood by force developers and joint doctrine writers.

The lack of joint doctrine is being felt in the field. Joint doctrine requires interoperability as a fundamental baseline since service UAS must be able to operate together, communicating, transferring data, sharing bandwidth seamlessly. This is not the case in the real world. According to the 2005 GAO report cited above, according to U.S. Central Command, "based on its experience in Persian Gulf operations, unmanned aircraft development has been

service-centric and lacks an overarching employment doctrine to shape development to achieve aircraft and sensor interoperable communications and payload commonality."[52] Yet improvements to interoperability (see acquisition discussion above) seem to be left to the initiative of the services, which may or may not have incentives to aggressively pursue improvements in this area.

An examination of existing joint doctrine for other types of aircraft can help frame the issue. For example, joint doctrine for an established theater regards almost all fixed-wing aircraft as being under the control of the Joint Force Air Component Commander (JFACC), regardless of service. Fixed wing aircraft quickly cover great distances, making their deconfliction essential. Cargo aircraft require special handling to allow them the extra maneuver space and protection they need. Without a central manager, the danger is that these considerations are left to lower level units that do not grasp the big picture and do not have the capability to provide that deconfliction. More importantly, and stemming from the Kasserine Pass lessons learned described previously, joint fixed wing doctrine insists that these assets are too capable and too scarce to be deployed "piece-meal" and potentially wasted on low priority targets. The doctrine demands a central manager with a good understanding of how the theater airspace must support the commander's overall intent and with the available systems to provide airspace control and deconfliction. An exception to this concept and one that might be instructive for the Army's view of UAS is the United States Marine Corps' (USMC) control of its fixed wing aircraft. Even during extended operations ashore, USMC fixed-wing aircraft remain under the control of the Marine Air Ground Task Force (MAGTF) and are controlled by the Direct Air Support Center (DASC) in airspace designated exclusively for USMC use. (Though it is true that the Marine Corps usually retains fighter aircraft for its exclusive use and

makes available support aircraft such as the EA-6B electronic warfare and C-130 cargo aircraft available to the JFACC, the reality is that the decision as to whether Marine Corps aircraft will be offered up for central management is made by the Marine Corps.) Currently, the US Army has no equivalent of the DASC, but given the growing number and importance of Army UAS and other air vehicles, efforts are underway to create a similar capability (this effort is discussed further below). It is possible that Army UAS could be accorded the same relation to supported forces as USMC aircraft are to USMC ground forces.

Joint helicopter doctrine is much more service-centric, as helicopters typically are acquired and employed for direct tactical support to service component ground commanders. Though there are exceptions to this rule (support to Combat Search and Rescue [CSAR] and Special Operations Forces [SOF] being the two major ones), helicopters are generally operated at the discretion of the owning service and are separated from theater fixed wing traffic using a coordinating altitude. It is important to remember that helicopters have relatively short ranges and loiter times when compared to fixed wing aircraft, including UAS. The Army's UAS also tend to be short-range assets, not limited by the vehicle's aerial capabilities but by the limitations of their communications suites, which permit only line-of-sight operations.[53] A joint doctrine for UAS could recognize the parallels to the services' helicopter fleets. It may be impractical to centrally manage many of the UAVs that will support future battlefields, just as there have been no attempts to centrally manage helicopters.

It is possible that new doctrine could acknowledge that UAS are not neatly comparable to fixed or rotary wing aircraft. UAS come in an increasing variety of shapes and sizes. Global Hawk has the wingspan of an airliner. The Navy and Army both intend to field the Firescout UAS, a rotary-wing helicopter that will operate well above 3500 feet. Micro-UAVs, or tiny bird

and even insect-sized unmanned aircraft will someday fill key roles for all services.[54] A new paradigm could acknowledge this variety and the wide scope of strategic, operational, and tactical tasks that these aircraft will be performing for all services by the end of the next decade. Some UAS will be strictly tactically focused and it will be impossible to fully track them from a central location such as the JFACC. Unexpected demands for overhead cover, such as for an emergency convoy or a Quick Reaction Team, require the decentralization of assets. Other assets, such as Global Hawk are clearly strategic assets and will remain so. They are large, expensive, complex aircraft that are specifically designed to focus on strategic targets. It is aircraft like the Predator and Warrior that are blurring the lines between strategic, operational, and tactical echelons, because they are capable of executing missions at each of these levels. Perhaps the real key is to focus on these types of vehicles and provide some way to satisfy both Air Force and Army needs.

A review of Air Force doctrine for ISR and Close Air Support (CAS) tasking sheds light on the difficulty of creating joint doctrine. Armed UAS appear to straddle both missions: are they strike or ISR platforms? Theater ISR requests are routed through the Air Operations Center (AOC), prioritized, and, if sufficiently important, matched with an appropriate collection platform on the Air Tasking Order (ATO). To make the ATO, requests typically must reach the AOC three days prior to execution. This works fine for traditional, static reconnaissance targets, but, for operations in Iraq, commanders are often seeking "hunter-killer," CAS-like capabilities when they seek UAS support.[55] The Air Force has a much different method of tasking for CAS. Immediate requests for CAS begin with the Tactical Air Control Party (TACP), typically at battalion and brigade levels, are routed through the Air Support Operations Center (ASOC) at corps headquarters, and are forwarded to the theater Air Operations Center (AOC). The request

is then matched with an available asset, one that might even be flexed from an existing mission should the emerging target be important enough. Therefore, a commander seeking the long dwell time, situational awareness, and armament provided by the Predator has a dilemma, especially when fast-moving developments create immediate windows of opportunity. He has no way of knowing three days in advance about a late-breaking development, but once he does he need it, it will be very difficult to pull a Predator from its ATO tasking. Instead, it may be easier to obtain CAS support through the ASOC, especially in the current war when air superiority is assured. The problem is that CAS does not provide the dwell time and situational awareness an armed UAV can provide, capabilities that have proven exceptionally valuable in irregular operations. An expert on this subject, Air Force Colonel David Hume, points out that this system often produces a mismatch of platforms to missions: 1) armed UAS conducting reconnaissance on static targets, resulting in missions that do not leverage the UAS's long dwell time or its responsive kinetic capability; and 2) CAS providing air support to ground commanders who would prefer longer periods of coverage and some method of video downlink (though fighters are increasingly able to provide this). Additionally, UAS full motion video (FMV) is not very useful for reconnaissance since, for technical reasons, it is hard to match its photos to precise map coordinates. Traditional ISR platforms are better for obtaining such coordinates, but on a day-to-day basis there are not enough of these in Afghanistan and Iraq. The UAV is especially useful for irregular operations because of its ability to track insurgents or terrorists over long times and distances and because the UAV is much quieter and less obtrusive than a fixed wing jet or turboprop. Finally, the Air Force requires CAS and armed UAS fires to be delivered by trained Air Force personnel, whereas the Army allows nearly any forward observer to coordinate for attack helicopter fires.[56] Therefore, the existing doctrine for tasking

these assets not only produces potential mismatches, but it feeds into the ground commander's perception that he must have his own organic UAS capabilities. Any joint doctrine for UAS will have to resolve the problem of how to appropriately task for UAS that can act as either ISR or strike assets.

A positive development in the area of doctrine is the recent movement of the Joint UAS Center of Excellence into Joint Forces Command (JFCOM). As a result of this reorganization, JFCOM now has the responsibility to oversee the JCOE mission to "develop joint CONOPS, TTPs [techniques, tactics, and procedures], and doctrine."[57] Though JFCOM is a relatively new organization, it is moving rapidly to develop the capabilities to quickly produce relevant joint doctrine. Now that some organization has the clear responsibility to develop joint doctrine, it can incorporate the lessons-learned that are flowing in daily from theater, and refine them through joint exercises and experiments. JFCOM may be able to seize on the DOD directive to "merge" the Sky Warrior and Predator programs as an opportunity to forge a test case for developing joint UAS doctrine.

AIRSPACE COMMAND AND CONTROL

The Air Force highlights a pair of serious problems relating to safety in controlled airspace. The Army appears to be aggressively leveraging airborne assets without necessarily accounting for the resulting airspace control issues that inevitably result. Many of the existing and planned UAS, designed to be as portable and mission-capable as possible, have no means to communicate their presence or identity to controlling authorities. This is a two-fold problem: a) airspace crowded with unknown UAS poses a danger to manned aircraft traffic; and b) without an Identification Friend or Foe (IFF) or similar capability, enemies could cloak the presence of

their own UAS in the resulting chaos. Though a coordinating altitude continues to separate Army and Air Force traffic, the Army's aggressive use of a variety of aerial vehicles and objects is placing pressure on and blurring this divider. However, it is in this area that there are the most mature potential solutions for these problems. The Army office responsible for developing doctrine for airspace command and control, the Training and Doctrine Command (TRADOC) Program Integration Office – Battle Command (TPIO-BC) Army Airspace Command and Control (A2C2) has been studying this problem and is developing three courses of actions for approaching this thorny problem.[58]

TPIO-BC notes that units in theater are coping with the problem of crowded airspace through ad hoc, innovative solutions. Additionally, they note that the problem is not restricted to Air Force concerns about the airspace above the coordinating altitude. TPIO-BC states that "the proliferation of low altitude airspace users is overrunning doctrine and practice in Iraq, leading to ad hoc solutions…"[59] Low-level Army airspace, or that below the traditional coordinating altitude, is becoming more and more crowded as the Army leverages the airspace above its battlefields to support operations. Helicopters, lighter-than-air vehicles, UAS, artillery shells, rockets, the Army Tactical Missile System (ATACMS), and the proposed "loiter attack munition" or LAM are just a few examples of Army aerial objects that will pass through low-level airspace. Since most of these can also easily exceed traditional coordinating altitudes, any solution for the Army airspace problem ought to include an accompanying Air Force solution. To that end, TPIO-BC has partnered with Air Force airspace experts to propose three potential courses of action to produce a joint solution to both services' airspace challenges.[60]

The first proposal is simply a variant on existing joint doctrine that assigns theater airspace responsibility to a single airspace control authority (ACA), normally the Joint Force Air

Component Commander or JFACC (almost always an Air Force commander). This proposal gives the ACA responsibility for everything above the coordinating altitude. When Army users need airspace that exceeds the coordinating altitude, they must request airspace control measures, such as restricted operating zones (ROZ). They are then listed in the airspace control order (ACO), which is developed on the same timeline as the ATO, to alert users throughout the theater. The new aspect would be a coordinating altitude that is set much higher than traditional levels. However, this simply gives additional airspace to the numerous Army users, providing no additional capabilities to control the larger airspace. This solution also does nothing to address the seam between the service airspaces. Finally, traditional ACMs would still be required for many Army operations, but reports from operations in OEF and OIF indicate that this method is failing to fully support the ground commanders, especially when the enemy forces changes to existing plans: "Requesting or changing a formal airspace coordination measure (ACM) outside of the normal airspace control order (ACO) is time-consuming and unresponsive, taking up to 20 minutes to process a single request."[61] This is simply too long on battlefield where conditions are changing so quickly.

A second proposal includes assigning the Army responsibility for a specific airspace sector within the theater airspace, up to some designated altitude (likely higher than current coordinating altitudes, perhaps 6,000 to 11,000 feet). The Army is already developing the capability to control this airspace, adding radars, the Tactical Airspace Integrating System (TAIS), and an 11-Soldier airspace control cell in the division headquarters. This capability would approximate the Marine Corps' Direct Airspace Support Center (DASC), which allows them to control designated airspace, typically over their area of operations at altitudes up to 11,000 feet. The main drawback to this proposal is that the Army would be unable to control

Air Force aircraft within the Army sector due to communications and training incompatibilities. Absent an Air Force representative in the emerging Army's airspace control cell, the "seams" between the services' respective airspace responsibilities remain and the Air Force's ability to enter the low-level airspace with confidence remains restricted.

Neither of the first two courses of action (COA) promotes the integration that joint operations require. A third proposed course of action does more to a) sufficiently control both lower and upper airspace; and b) address the seam between the services' airspace sectors of responsibility. This COA would entail the Army and Air Force developing a joint capability to control everything within an airspace sector delegated by the ACA to cover an Army area of operations. To address the seam and to permit entry or transit of the airspace by Air Force aircraft, the Army would require the addition of Air Force personnel to the Army division headquarters airspace control cell to both control Air Force assets in the delegated Army airspace sector and to help train Army controllers in Air Force procedures. This Air Force "advocate" should give Air Force airspace users the confidence to enter and operate in delegated Army airspace sectors. It is important to note that this proposal is in accord with current joint doctrine, builds on emerging Army capabilities, presents a relatively small bill to the Air Force, and is endorsed by Air Force airspace command and control experts who are helping develop this COA. Its biggest drawback is that requires significant paradigm shifts for various airspace users. The Air Force would have to adjust from the current philosophy of a single airspace control authority (though extended operations by the Marines ashore, utilizing their DASC to control a delegated Marine airspace control sector, have set somewhat of a precedent). Army aviators would perceive the change as intruding on the traditional freedom of maneuver they have enjoyed beneath the coordinating altitude that allows them to flexibly support ground operations.

Finally, the fires community would have to accept the "control" of fires by this joint A2C2 element. TPIO-BC continues to refine this solution, seeking answers to questions such as how large an Army airspace could be controlled, how many aircraft could accommodated in Army airspace, and how this concept would work in unusual or unique situations with non-contiguous airspace regimes.

This course of action leverages a unique window of opportunity for change, as both the Army and the Air Force are in the midst of transforming their respective airspace control elements. The Army is re-designing its division headquarters element, which contains an airspace control element that, with a little further refinement, could provide a DASC-like capability. At the same time, the Air Force is modernizing both its Tactical Air Control Party (TACP) and Air Support Operations Center (ASOC) designs, changing them to better match the Army's transformation to the modular force. These emerging designs have most of the ingredients that would be required to allow the Army the ability to command and control all air traffic, regardless of type, service or nation, in a designated sector. Again, the capability would be very much like that currently owned by the Marine Corps and for which there is well-established doctrine. The addition of reliable beyond-line-of-sight (BLOS) communications capability and Air Force enroute controllers, to both handle Air Force traffic, provide a conduit to the Control Reporting Center/Airborne Warning and Control System (CRC/AWACS) and to train Army controllers in Air Force procedures.

The proposed Army/Air Force airspace control element (ACE), capable of controlling designated airspace above a division area of operations, anticipates a further improvement to airspace command and control, the emerging Joint Air Ground Control Cell (JAGC2).[62] The concept for this cell goes beyond manned and unmanned aircraft, acknowledging the reality that

the ground forces will increasingly leverage the skies to enhance their operations. The JAGC2 cell would integrate the Army/Air Force ACE described above, as well as cells that currently manage division indirect fires, air defense artillery, ISR, and other non-kinetic operations. The JAGC2 would "provide the commander with the ability to plan, coordinate, deconflict, and control all third dimensional operations in the airspace above the division or corps AO in real time or near real time…"[63] Essentially, the JAGC2 leverages the ongoing shift of thinking from *deconflicting* operations to actually *integrating* joint assets. Because of interoperability problems, in the past deconfliction was the best the military could hope for on a complex, rapidly changing battlefield. The time seems ripe for taking advantage of the same technological advancements that have improved the combat decision processes to integrate the joint airspace operations that will support them.

This last COA will require relatively small investments from both the Army and Air Force, but it is worthwhile to review the reasons why these investments are worth making. The Army has good reasons for seeking decentralized, organic UAS support. First, the Warrior represents a demonstrated and JROC-approved requirement for tactical UAS that can provide ISR, strike, and communications relay capabilities to its modular force. In redesigning its division-based forces to be smaller, more discrete and tailorable units that can be both rapidly deployed and more easily sustained, the Army was forced to make some hard choices. Each BCT, once consisting of three armored or mechanized battalions and a reconnaissance squadron, now includes just a total of three combat battalions. This represents a significant drop in firepower and reconnaissance capability, which will be offset by armed UAVs. As one early Army enthusiast put it in 1997, "I will give up a tank battalion for a UAV company."[64] His

words have proved prophetic as ground formations have now been designed to require just that UAV company.

Second, the Army's culture and leadership doctrine emphasizes a thorough understanding of the commander's intent. It is the Army's experience that there is no replacement for fighting with the commander, physically present at his side, for understanding his requirements and being able to rapidly respond to them. The Army is skeptical that a remotely operating pilot will be able to fully grasp the commander's intent, especially in the midst of confusing, rapidly changing circumstances. The Army culture expects physical co-location of supporting and supported operators as this produces a thorough understanding of the commander's intent, critical during battle when the ground commander may not have time to thoroughly explain his needs to a supporting commander. The 10th Mountain Division's General Hagenbeck, in response to a question about UAS support to his division's operations in Afghanistan, stated: "The UAV operator needs to be sitting next to the ground tactical commander. In this instance, he was sitting in Saudi Arabia. At times the UAV moved out of area we wanted to look at, and we had to go through channels with a request to redirect the UAV's search."[65] Physical presence also provides opportunities for supporting commanders to participate in briefings, rehearsals, and briefbacks. The Army promotes integrated operations, with all participants fully understanding the plan and adjusting from it, quickly reacting to a thinking, moving, and ambitious enemy. Finally, the Army values shared risks and hardships, believing this will produce intangibles that are proven combat multipliers: mutual trust, confidence, camaraderie, esprit de corps, and so on.

A commonly held belief about modern warfare is that, while in the past the enemy was "easy to find but hard to kill," today the enemy is "easy to kill but hard to find." This is especially true of irregular warfare, in which the enemy rarely presents himself as an obvious

target, taking advantage of urban or restricted terrain, blending into the civilian populace, and rarely massing. DOD leaders believe that "the future security environment includes a mix of military and non-military challenges by state and non-state actors to US national security, with IW (irregular warfare) as the favored form of warfare of those who would be our adversaries."[66] This suggests that there will be a premium placed on assets that can help find an extremely elusive opponent. The Army's position is that it must leverage technology such as the UAS to do just this. The Air Force also recognizes the important contributions that UAS will make in irregular warfare, "continuously monitor[ing] the situation on the ground, helping identify insurgents as well as their organizational networks, supporters, and line of communication and supply."[67] Nevertheless, the "clash of cultures" and the seemingly endless competition for roles and missions—and the budgetary dollars that go with them—will continue to separate the Air Force and Army UAS programs. (Though the Marine Corps and Navy also have UAS programs, to date they have kept lower profiles on this issue, allowing the Army to take the lead and quietly supporting its position. Their arguments for retaining authority for the acquisition and operation of their own UAS are similar to those of the Army: the special requirements of the domain within which they operate will require unique, service-specific solutions.) The Army will relentlessly continue to seek organic possession of UAS to ensure these increasingly important assets are tightly linked to ground commanders' concepts of operations and schemes of maneuver. The Air Force will continue to pursue central management of limited and very expensive aircraft fleets and of the theater airspace in which they operate. The recommendations below represent some proposals for a middle ground between these two visions for UAS.

RECOMMENDATIONS

It is important to break the impasse between the Army and Air Force philosophies regarding UAS. In all future conflicts, each service will deploy large numbers of UAS that should be interoperable in key areas and that should operate under an overarching joint doctrine that receiving combatant commanders can easily grasp and implement. Unfortunately, friction between the Army and Air Force hinders such integration. Advances in technology are permitting the Army to design and field cheap and innovative aerial platforms that will solve a host of ground-based tactical, logistical, and command-and-control problems. From the Air Force perspective, this proliferation of airborne vehicles intrudes on their traditional roles and missions and on their responsibilities for commanding and controlling theater airspace. The two services need to frankly face this dispute and leverage recent developments for a real way forward. To this end, the Secretary of Defense should adopt the following recommendations:

Executive Agency. The Air Force should accept Undersecretary England's recent decision and cease efforts to obtain executive agency over DOD UAS. DOD has repeatedly recognized that, though the efficiency and uniformity that an executive agent might produce are tempting prospects, there are some problems with putting one service over an asset that could have very different applications depending on operating domain. One respected analyst sums up DOD concerns:

> "The Air Force attempt to consolidate control over UAVs has everything to do with its long-term future. While coordination and standardization is necessary across the services, each step in that direction will diminish innovation. No branch fully understands the true promise of UAV technology, which has only just gotten off the ground. But if the Air Force is allowed to consolidate control over UAV systems, especially based on altitude, then bureaucratic and organizational barriers will impede a broad generational leap in the technology for all the branches." [68]

Undersecretary England's recent decision regarding the Air Force's pursuit of EA should be definitive. The time for any service bid for executive agency has passed. Instead, Air Force leaders should join the other services in seeking ways to leverage other organizations to address the issues that have caused them concern.

Key West-style Interoperability Conference: The services should meet for a formal conference to agree upon minimum standards of interoperability. Once these standards are agreed upon, DOD should ensure their enforcement on future service proposals (see below). The services should negotiate shared standards in the areas of communications, data-transfer, identification friend-or-foe (IFF) capabilities, fuel type, launch/take-off and remote piloting procedures. The bottom line is that for a joint doctrine to be effective, a certain minimum degree of interoperability will be vital. Once these minimums are settled, they can underpin improvements in other areas.

Leverage the Joint Unmanned Aerial Systems (JUAS) Center of Excellence (COE). Recently, responsibility for the operation of the JUAS was transferred to Joint Forces Command (JFCOM). DOD should ensure that this organization is a dynamic organization that is used to develop cross-service synergies, ensuring that innovative approaches, advanced technology and

lessons learned from theater are melded together to produce relevant timely joint doctrine. A distinct advantage of the JUAS COE is highlighted in a recent article by noted defense thinker Adam Stulberg who argues that it provides the opportunity to bypass the roadblocks that contribute to the current impasse, instead facilitating "problem-solving, information exchanges, and common benchmarks to reconcile different approaches to qualifying operators and managing theater airspace."[69] In other words, operators often manage to find clever, elegant ways for circumnavigating problems that look impossibly difficult at the highest levels of bureaucracy. To produce these results, the following additional recommendations should be adopted:

- Station operational UAS units from each service at this location. These organizations should be at least company-sized and will provide the test bed that will allow concepts to be thoroughly tested.

- Increase service presence at this location. Currently, the JUAS COE has only 64 active military from across all services stationed at the JUAS COE. This level of staffing is insufficient for developing shared practices that can ultimately be developed into joint doctrine by JFCOM. A larger service presence would demonstrate commitment to supporting the JUAS COE. SECDEF should direct that the services at least double this presence.

- JUAS COE personnel should review all service UAS program proposals for adherence to the minimum interoperability standards described above. Additionally, they should examine all proposals to ensure they will fit into established doctrine and emerging

concepts. Both these steps should be accomplished prior to these proposals being briefed to the JROC.

Leverage the JROC. JROC should not review any service proposals for UAS unless they have been approved by the JUAS COE. The current JROC process is not sufficiently producing "jointness" for proposed UAS programs. The use of some minimum standards will help the JROC judge whether proposed programs have adequate levels of interoperability.

Leverage the Recent Decision by Undersecretary of Defense England It would be a waste of time and effort to attempt to fix all current stove-piped UAS systems in one broad effort. Ad hoc solutions, though inelegant and potentially wasteful, are adequate to support UAS operations in theater. Reports of "near misses" in theater appear to be exaggerated and, other than the inevitable requests for more assets, supported commanders appear generally satisfied with current arrangements. All involved should now concentrate on going forward, beginning with a focused effort on the merged Sky Warrior and Predator programs. Though Undersecretary England directed it, he provided no specific guidance on what it means to "merge" these programs. Use the Key West-style conference described above to set standards for the merged program. To provide interoperability that will support development of joint doctrine, the following specific standard should be applied:

- Both Line of Sight (LOS) and Beyond Line of Sight (BLOS) remote piloting capability
- Compatibility with both the Army GCS and Air Force satellite linked piloting system
- Compatibility with the Army's ROVER-D video downlink capability allows transition of captured video to appropriate maps
- Heavy fuel engine, which will allow refueling at both Army and Air Force facilities.

- IFF capability
- Configurations that will accommodate all payloads, whether of Air Force or Army origin

Army Airspace Command and Control Capability. The Army, with the assistance of the Air Force, should continue efforts to develop an airspace command and control capability similar to that possessed by Marine Corps. This will allow the Army to command, control, track, and deconflict all assets within a discrete block of airspace, typically over large ground forces in the theater designated by the JFACC. The presence of Air Force personnel and Air Force equipment will allow Air Force aircraft to enter and operate in Army-controlled airspace with confidence. The Army should pay the relatively small personnel and materiel bills associated with this new organization.

Direct Change to Army Deployment Practices. The Army should sincerely commit, through official doctrine and practice, to jointness in two ways. First, the Army should develop means of contributing unused sorties when units are out of contact. Experience has shown that these aircraft can be used nearly around the clock and should be shared when possible. Second, because of imposed minimum standards, the merged Warrior/Predator UAS could have the ability to support both Air Force strategic/operational missions and the Army's tactical missions. Therefore, UAS assigned to ground brigades not deployed to theater can be deployed to support Air Force requirements, addressing their concerns that valuable assets would be wasted by Army's insistence on organic assignment of UAS. This will be a difficult shift in paradigm for the Army to accept, but will be necessary as the costs of more and more capable UAS rise and available resources decline. The Army will have to develop innovative ways to train Army units

that have detached their UAS, which may include support from sister organizations, from centrally managed spares or from aircraft at training centers.

CONCLUSION

The UAS will continue to be fixtures on the modern battlefield. However, current DOD programs have been developed in the absence of joint guidance and are "out of synch." Combatant commanders receiving component forces will find that the incoming assets come with a large number and wide variety of UAS. DOD owes these commanders a coherent vision for how these UAS can sometimes be operated jointly and how they will be used by the services to support their unique requirements. This will require joint acquisition standards that produce some minimal level of interoperability, joint doctrine that provides a common reference, and a shared understanding of how theater airspace will be commanded and controlled. The recommendations proposed above are rooted in the realities of the current DOD system. Budgetary realities mean that all new weapons systems will continue to be developed and paid for by the services. Program realities are that most of the current UAS have come to maturity without joint guidance and it would be too difficult and costly to reengineer them. This is why efforts for improvement must leverage existing agencies and procedures and should, at least initially, be focused narrowly. As recommended above, DOD should adjust JROC procedures to enforce minimum joint standards for UAS, should leverage the joint perspective provided by JFCOM and its JUAS COE to produce joint doctrine, and should use the merger of the Army Sky Warrior and Air Force Predator programs and their subsequent operations to establish the future model for UAS jointness. Though most of the DOD UAS programs have not been synchronized to date, the failure of the Air Force's attempt to achieve executive agency may

ironically provide the impetus for the synchronization that the DOD UAS community needs and deserves.

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ENDNOTES

[1] This phrase can be found in numerous official and unofficial Air Force documents, articles, and doctrinal manuals. Just one recent example is in Major General Allen G. Peck, "Airpower's Crucial Role in Irregular Warfare," *Air and Space Power Journal* 21, no 2 (Summer 2007): 12.
[2] A comprehensive history of the United States Army's commitment to overwhelming mass and firepower with little regard for efficiency is found in Russell Weigley, *The American Way of War* (New York, NY: Macmillan, 1973).
[3] A good review of the tension between Air Force efficiency and Army effectiveness and a solution that bridged it can be found in Charles E. Kirkpatrick, "Joint Fires as They Were Meant to Be: V Corps and the 4th Air Support Operations Group During Operations Iraqi Freedom," Land Warfare Paper No. 48 (Arlington, VA: The Institute of Land Warfare, Association of the United States Army, October 2004), 1-22.
[4] DOD has recently directed the use of the term Unmanned Aerial System (UAS) to highlight the fact that the effective employment of Unmanned Aerial Vehicles (UAV) requires, in addition to the aircraft itself, launch systems, ground control terminals, recovery systems and other ground support equipment.
[5] These questions, in a variety of forms, are being asked throughout DOD. For example, during 2007 Joint Forces Command received a request from CSAF to study whether existing airspace command and control doctrine continued to be relevant. This request was based on challenges noted during operations in support of Operation Iraqi Freedom (OIF). Also, during 2007 the Air Force commissioned a RAND Corporation Study titled "Airspace Defense, Control, and De-Confliction on the Future Battlefield," the purpose of which will be to address the fact that "the proliferation of unmanned systems on the battlefield has limited [the] ability to characterize and control airspace, and the desire to flexibly employ these systems has led to conflicting views among the Army and the Air Force on the most appropriate means and measures for airspace control and defense." Finally, as noted later in this paper, an Army Training and Doctrine Command office is studying these questions.
[6] Amy Butler, "Line in the Sky," *Aviation Week and Space Technology*, 2 April 2007, 51-52.
[7] Hugh McDaid and David Oliver, *Smart Weapons*, (London, UK: Orion Publishing Group, 1997), 10.
[8] Christopher Bolkcom and Elizabeth Bone, *Unmanned Aerial Vehicles: Background and Issues for Congress*, (Washington, D.C.: Congressional Research Service, The Library of Congress, 2003), 14.
[9] Sue Baker, "Predator Missile Launch Totally Successful," Aeronautical Systems Center Public News Release, Wright Patterson AFB, Ohio, 27 February 2001.
[10] John Schlight, *Help from Above: Air Force Close Air Support of the Army 1946-1973*, (Washington, DC: Air Force History and Museums Program, 2003), 257.
[11] An excellent and more detailed comparison between the Predator and Warrior can be found in David B. Hume, *Command, Control, and Integration of Weaponized Unmanned Aircraft Into the Air-to-Ground System*, (Maxwell AFB, AL: Air University Press, 2007).
[12]Bolkcom and Bone, "Unmanned Aerial Vehicles: Background and Issues for Congress," 14.
[13] Rebecca Grant, "The Drone War," *Air Force Magazine*, July 2007, 36-40.
[14]A good review of the events leading to Undersecretary England's decision is found in John A. Tirpak, "The Struggle Over UAVs," *Air Force Magazine*, November 2007, 32-36
[15] Department of Defense, *Unmanned Aircraft Systems Roadmap 2005-2030*, (Washington, DC: Office of the Secretary of Defense, 4 August 2005), 17.
[16] Tirpak, "The Struggle Over UAVs," 32-36.
[17] Department of Defense Directive 5101.1, *DoD Executive Agent*, 3 September 2002, 2.
[18] Ibid.
[19] Defense Industry Daily, "Warrior ERMP: An Enhanced Predator for the Army," 18 October 2007, http://www.defenseindustrydaily.com/warrior-ermp-an-enhanced-predator-for-the-army-03056/#more.
[20] Daniel R. Mortensen, *A Pattern for Joint Operations: World War II Close Air Support, North Africa*, (Washington, DC: Office of Air Force History and U.S. Army Center of Military History , 1987), 71-73.
[21]General Dwight D. Eisenhower quoted in Albert F. Simpson, "Tactical Air Doctrine: Tunisia and Korea," *Air University Quarterly Review* 4, no. 4 (Summer 1951): 15.
[22] Grant, "The Drone War," 38.
[23] Loren B. Thompson, "Army Plans for Reconnaissance Drones Misuse Vital Assets," Lexington Institute, 5 September 2007, http://lexingtoninstitute.org/1162.shtml.

[24]Christopher Boetig, "Battlefield Airspace Control," (working paper, Training and Doctrine Command Program Integration Office-Battle Command, Fort Leavenworth, KS, January 2007), 1.
[25] Schlight, *Help from Above: Air Force Close Air Support of the Army 1946-1973*, 257.
[26] Chuck Harrison, "How Joint Are We and Can We Be Better?," *Joint Force Quarterly* 38 (July 2005): 15.
[27] Ibid.
[28] Comptroller General of the United States, *Military Readiness: Lingering Training and Equipment Issues Hamper Air Support of Ground Forces*, (Washington, DC: General Accounting Office, 2003).
[29] Williamson Murray and Major General Robert H. Scales, Jr., *The Iraq War: A Military History*, (Cambridge MA: Harvard University Press, 2003), 209.
[30] Grant, "The Drone War," 39.
[31] LTC (Ret) Keith Lembke, 4th ID G3 Air during OIF 4 rotation, email to author, 24 October 2007.
[32] Kenneth B. Sherman, "Fire Scout Chosen as US Army FCS TUAV," *Journal of Electronic Defense* 27, no. 3 (March 2004): 30-31.
[33] BG Stephen Mundt, "Landpower" (lecture, Air War College, Maxwell AFB, AL, 19 November 2007.)
[34] Tirpak, "The Struggle Over UAVs," 32-36.
[35]"Washington Report," *Seapower*, July 2007, 8-9.
[36] Comptroller General of the United States, *Unmanned Aircraft Systems: DOD Needs to More Effectively Promote Interoperability and Improve Performance Assessments* (Washington, DC: General Accounting Office, 2005).
[37] Office of the Joint Staff, *Joint Concept of Operations for Unmanned Aircraft Systems*, (Washington, DC: Office of the Joint Staff, March 2007), I-3.
[38]Chairman of the Joint Chiefs of Staff Manual 3170.01C, *Operation of the Joint Capabilities Integration and Development System*, 1 May 2007, A-1.
[39]"Joint Unmanned Aircraft System Center of Excellence," PowerPoint Briefing (Joint UAS Center of Excellence, Creech AFB, NV, January 2007).
[40] Ibid
[41] Ibid
[42] John A. Tirpak, "Washington Watch," *Air Force Magazine*, November 2007, 13.
[43] This contention is based on the author's personal experience during two years of service in the US Army Aviation Directorate of Combat Developments. Though it was important to produce the correct documentation to get through the JCSIDS and JROC processes, there was never any real concern that proposals that had the support of the senior Army leadership would be seriously challenged.
[44] Glenn W. Goodman, Jr., "Coming Together," *Seapower*, April 2007, 54.
[45] John F. Donnelly, "Panel Probes Military's Fight for Radio Waves," *Defense Week*, 22 April 2002, 3.
[46] Lt Col Kurt A. Klausner, "Command and Control of Air and Space Forces Significant Attention to Bandwidth," *Air and Space Power Journal* 16, no. 4 (Winter 2002): 70.
[47] Caitlin Harrington, "USAF Eyes UAVS with Reduced Demands on Bandwidth, Spectrum," *Jane's Defence Weekly* 44, no. 33 (15 August 2007): 7.
[48] "ER/MP Extended Range Multi Purpose UAV," *Defense Update*, Winter 2005, http://www.defense-update.com/products/e/ermpUAV.htm.
[49] Joint Publication 3-55.1, *Tactics, Techniques, and Procedures for Unmanned Aerial Vehicles*, 27 August 1993, II-3.
[50] Air Land Sea Application Center Field Manual 3-04.15, *Multi-Service Tactics, Techniques, and Procedures for the Tactical Employment of Unmanned Aircraft Systems*, August 2006.
[51] Comptroller General of the United States, *Unmanned Aircraft Systems, Advance Coordination and Increased Visibility Needed to Optimize Capabilities*, (Washington, DC: General Accounting Office, 2007), 17.
[52] Comptroller General of the United States, *Unmanned Aircraft Systems: DOD Needs to More Effectively Promote Interoperability and Improve Performance Assessments*, 13.
[53] Thompson, "Army Plans for Reconnaissance Drones Misuse Vital Assets," September 5, 2007.
[54] "Miniature Aerial Vehicles Research," *Defense Update* 2 (2004), http://www.defense-update.com/features/du-2-04/mav-darpa.htm
[55] Air Force Doctrine Document 2-9, *Intelligence, Surveillance, Reconnaissance Operations*, 21 November 2005, 12-13.
[56] Hume, *Command, Control, and Integration of Weaponized Unmanned Aircraft into the Air-to-Ground System,"* 13-15.
[57] "Joint Unmanned Aircraft System Center of Excellence," PowerPoint Briefing.

[58] These proposals are presented in a recently published white paper, Christopher Boetig, "Battlefield Airspace Control," (working paper, Training and Doctrine Command Program Integration Office-Battle Command, Fort Leavenworth, KS, January 2007).
[59] Ibid.
[60] Ibid.
[61] Curtis V. Neal, "JAGC2: A Concept for Future Battlefield Air-Ground Integration," *Field Artillery Magazine*, November-December 2006, 15.
[62] Ibid, 13-17.
[63] Ibid, 13.
[64] MG Paul J. Kern quoted in Rebecca Grant, " The Drone War," *Air Force Magazine*, July 2007, 39.
[65] Robert H. McElroy, "Afghanistan: Fire Support for Operation *Anaconda*," *Field Artillery Journal* (September-October 2002), 9.
[66] US Special Operations Command and US Marine Corps Document, Version 1.0, *Irregular Warfare (IW) Joint Operating Concept (JOC)*, June 2007, 7.
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[68] Strategic Forecasting, , "Managing the Rise of the UAV," August 25, 2007, http://www.stratfor.com/u_s_managing_rise_uav_0.
[69] Adam Stulberg, "Managing the Unmanned Revolution in the U.S. Air Force," *Orbis* 51, no. 2 (January 2007): 264.