Global Hawk and Persistent Awareness
Sizing the Global Hawk Fleet

by
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Executive Summary

The current and forecasted security environment contains multiple challenges to the United States: a major theater war involving conventional armies, navies and air forces; irregular warfare against trans-national terrorists and insurgents; hostile states or non-state actors using weapons of mass destruction; and an adversary fielding disruptive technologies. Uncertainty is a common characteristic in this security environment. In order to reduce the uncertainty, commanders must construct a layered Intelligence, Surveillance and Reconnaissance (ISR) network to provide persistent awareness of their theater.
“Persistent awareness” is the *sustained ability to monitor or surveil a wide area while concurrently obtaining detailed, precision target quality information on targets, forces or similar points of interest*. In the past, Commanders have used ISR systems to improve their understanding of the battlespace, alerting them to potential hostile activities while using additional systems to gain detailed information. In today’s security environment, the missions given to military commanders require them to have constant awareness of activities in their area of responsibility (AOR).

In the past, commanders used layered ISR networks to gain battlespace awareness in conventional theater conflicts. The impending retirement of the U-2 and P-3 aircraft, however, necessitates a review of how follow-on systems will integrate or alter the existing architecture. In addition, the global war on terror has created requirements exceeding the current ISR forces’ availability. For example, the Air Force’s fleet of 14 RC-135s can sustain one deployed orbit continuously. Likewise, the U-2 fleet cannot sustain daily operations in the Middle East and Asia. These scarce resources must be matched against combatant commander requirements to monitor not only hot spots in Iraq and Korea, but also known terrorist locations in the tri-border area of South America, the Pan-Sahel region of Africa, Chechnya, the Mediterranean, the Strait of Malacca plus 27 other land and maritime areas that the National Security Strategy identifies as warranting persistent monitoring. The Combatant Commanders’ requirements exceed available resources.

The Global Hawk unmanned aerial system (UAS) is the next generation surveillance and reconnaissance system that complements theater ISR capabilities as part of a layered ISR network. When its radar operates in the moving target mode or its signals intelligence antenna searches for electronic emissions, Global Hawk provides the wide area surveillance required to alert US forces to activities of interest. When detailed target imagery is needed, Global Hawk’s electro-optical (EO), infrared (IR) and radar sensors can extract precise imagery intelligence. When these sensors are combined on a high altitude, long endurance aircraft, such as Global Hawk, commanders gain a tool to minimize shortfalls in their existing layered ISR network and meet their persistent awareness needs.

This paper examines the future security environment to describe why persistent awareness is required, what is needed, and how Global Hawk contributes to meeting these persistent awareness requirements. It also examines Global Hawk’s contribution to maritime domain awareness, ballistic missile defense and border security. In sizing the fleet to meet these missions, this paper postulates that 157 operational Global Hawks are required for theater commanders and homeland security officials to accomplish their surveillance missions. The number of operational aircraft required will change as Global Hawk’s capabilities mature and become better understood. The analysis in this paper should frame the discussion.

### Summary of an illustrative Global Hawk fleet.

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I. Demand for Persistent Awareness

Today, the United States faces a demanding security environment. In its National Defense Strategy of March 2005 and again in the Quadrennial Defense Review (QDR) a year later, the U.S. Department of Defense (DoD) characterized this environment as one of uncertainty. Uncertainty, however, does not relieve military planners from developing force structure requirements. Indeed, the most important force structure investments may be those capabilities—intelligence, surveillance and reconnaissance (ISR) forces—that lower the level of uncertainty. Commanders must have ISR forces for a range of military operations—from peace through crisis to war—to understand their battlespace and potential adversaries.

The National Defense Strategy and QDR articulated four challenges to help define the capabilities needed by the nation’s armed forces. Reviewing the scenarios used in these studies—traditional, irregular, catastrophic and disruptive challenges—provides insight into the ISR capabilities needed.

A traditional threat from countries employing modern armies, navies and air forces in a theater conflict is the first challenge to the U.S. In this scenario, U.S. forces must deter, and if that fails, defeat a hostile state and its armed forces. U.S. forces must be capable of several tasks: ascertaining detailed information about the adversary and their forces, capabilities, operations and intent; deploying and employing lethal firepower; commanding and controlling joint and allied forces to gain the right effects at the right time; and sustaining these forces. DoD anticipates that U.S. forces must be capable of conducting multiple major combat operations, if required.

The Defense Department also articulated that U.S. forces need increased capabilities to confront the second challenge: irregular warfare. The Chairman of the Joint Chiefs, Admiral Michael Mullen, has stated that U.S. forces require more ISR to address time-sensitive targeting requirements associated with Irregular Warfare.

Irregular warfare, however, is a singular term that represents a variety of adversaries—from trans-national terrorist organizations to large-scale insurgencies. Terrorist organizations, like al Qaeda, are global in nature and act periodically to create traumatic, media-centric events. In contrast, insurgents concentrate their operations in one country or region, have a larger number of active participants and are more likely to engage in a continuous campaign to pursue specific political objectives.

Despite their differences, trans-national terrorists and insurgents have common traits driving ISR requirements. The irregular warfare challenge, regardless of the adversary, requires an ability to locate and track hostile individuals or small groups dispersed among non-combatant populations. U.S. military commanders will need ISR capabilities oriented on the protagonists’ plans, capabilities, locations and support networks. These ISR capabilities must penetrate a wide array of environments—from complex urban settings to desolate caves in remote mountains. Finally, ISR capabilities must

Figure 1-1: Challenges facing U.S. military forces.
decipher adversaries’ communications across a range of media—from messages in the modern global telecommunications network to those communicated by the ancient word-of-mouth method.

The QDR identified the proliferation or use of weapons of mass destruction (WMD) as the third challenge facing the U.S. State and non-state actors seek WMD devices to paralyze U.S. national power through either intimidation or direct use with cataclysmic results. The QDR pointed to porous borders, weak international controls on technology transfer and the availability of nuclear weapons information on the internet as factors increasing the risk of such weapons falling into an adversary’s hands.3

Preventing the acquisition and use of WMD presents a daunting challenge to military commanders because hostile entities range from sovereign states, like Iran and North Korea, to non-state actors like al Qaeda. To meet these challenges, military commanders need many of the same ISR capabilities identified for the first two challenges. Commanders require systems that can collect information on sophisticated research and manufacturing infrastructure used to produce WMD and sensors that detect how, when and where WMD are stored, transported and employed. Once aware of the hostile agents’ capabilities, military commanders need agile command and control tools, prompt global strike or force deployment options and precision weapons to negate the WMD threat without placing civilian populations at risk.

Finally, the U.S. will be challenged by an adversary seeking disruptive capabilities—revolutionary technology and innovative employment doctrine to negate U.S. military superiority. The QDR postulated that such disruptive breakthroughs could occur in biotechnology, cyber operations, space or directed-energy weapons.4 Again, commanders will need ISR systems that can penetrate an adversary’s research infrastructure to ascertain technologies, operational concepts and emerging threats.

DoD articulated these four challenges in order to “translate strategy into guidance to shape and size military forces.”5 As such, the challenges assist military commanders in defining their operational requirements to guide programmatic and budgetary decisions. Of note, DoD specifically stated that the requirements of irregular warfare will determine the size of the force as much as traditional conflicts have in the past.6 This policy departs from previous programmatic guidance where irregular warfare was a “lesser included” contingency of the conventional capabilities and therefore was not accorded specific force or budgetary commitment.

In reviewing the QDR’s four scenarios, ISR capabilities stand out as a salient common requirement. In fact, the QDR refers to intelligence capabilities more frequently than it does to SOF, precision strike, mobility, combat forces, command and control or any other operational capability. Furthermore, the document describes the need for “better fusion of intelligence and operations” as the cornerstone for meeting these challenges. This reference to improved “intelligence and operations” reflects the need to go beyond the previous concepts of “reconnaissance” and “surveillance.” Traditionally, military planners have viewed reconnaissance as a preplanned activity—allowing the intelligence community to analyze and exploit the data gained from a discrete location. On the other hand, surveillance has been a dynamic activity—monitoring a wide area and providing data directly to operators so they can adjust forces in real time, such as when an AWACS directs F-15s to intercept hostile aircraft. Merging these distinct activities gives rise to the new concept: persistent awareness.

**Persistent Awareness:** The sustained ability to monitor or surveil a wide area while concurrently obtaining detailed, precision target quality information on targets, forces or similar points of interest.

All four QDR scenarios suggest that military commanders need persistent awareness to accomplish their missions and have a faster decision cycle than potential adversaries. The remainder of this paper addresses how commanders gain persistent awareness from a layered ISR system and discusses specifically the size of the Global Hawk fleet required to provide that capability.
II. Enabling Persistent Awareness

In reviewing the QDR’s challenges, persistent awareness is a capability required in all four scenarios. This section reviews how commanders orchestrate ISR sensors into a layered network in pursuit of persistent awareness. Figure 2-1 summarizes key ISR platforms and their contributions in terms of sensors, geography and time.

Layering Sensors in Search of Persistent Awareness

Commanders gain information about their battle-space from many sources. Airborne early warning (EW) radars, such as E-2C HAWKEYE surveillance radar, a E-8 Joint STARS ground surveillance radar or an AEGIS cruiser AN/SPY-1D phased array radar, are tools that provide a wide area surveillance (WAS) capability. These sensors produce movement target intelligence (MTI)—detecting and tracking objects in motion.

Signals intelligence (SIGINT) sensors also provide WAS—where communications and electronic antennas scan to intercept transmissions. SIGINT sensors on the surface can operate indefinitely, such as the Prophet Ground system; but, their range is limited. Placing the SIGINT sensor on an airborne platform, such as the RC-135 RIVET JOINT or EP-3, increases the sensor’s coverage area; however, these platforms have limited endurance due to human performance constraints. Space assets provide wide area and long endurance SIGINT collection, but their coverage area and timeliness of collection depends on their orbital revisit rate.

Commanders gain detailed information with electro-optical (EO), infrared (IR) and radar imagery intelligence (IMINT) sensors. The timeliness of IMINT products varies. Space-based IMINT satellites can access select locations over a period of years; however, they often image one specific location only once each day for 15 minutes or less due to orbital mechanics. Airborne systems, like the U-2, can provide near-real time images if they are equipped with the extended tether program transmitter. Other airborne platforms, like the MQ-1 Predator or P-3 Orion, provide near-real time streaming video of a specific target location. Commanders can direct these systems to high priority areas of interest, but U-2s, Predators and P-3s have limited on-station time.

No matter what platform they are on, each ISR sensor provides key data to commanders; however, linking the sensors in a network or architecture yields synergy far beyond the output of a single sensor. By layering sensors—of the same and different types—commanders exploit one sensor’s contributions while minimizing its shortfalls with a second or third sensor. Multiple SIGINT sensors operating on different axes to an emitter can pinpoint an emitter’s location faster. With sensors at different altitudes, commanders can observe more surface area as well. For example, a U-2 at 60,000’ can “see” nearly three times the surface area in vertical terrain as a J-STARS at 30,000’. Cross-cueing between different sensor types, such as SIGINT sensors cueing IMINT sensors, permits commanders to characterize or identify targets faster—accelerating the kill chain.

Collectively, the persistent awareness gained from layered sensors does more than create a three dimensional picture of the battlespace. Multi-sensor data, collected in a sustained manner, increases commanders’ understanding of the battlespace. It creates an information mosaic—reducing gaps in information and giving commanders the best insight into an adversary’s capabilities, plans, operations and intentions. The more detail the mosaic has—the better the commander’s persistent awareness is.

\[^a\] U-2s can also provide near-real time images when within 220 miles of a ground station.
OPERATION IRAQI FREEDOM—LAYERED ISR IN ACTION

Operation IRAQI FREEDOM (OIF) provides a recent example of how an air commander employed a layered airborne ISR network to support the joint warfight. Starting at the greatest height, space forces provided continuous coverage by monitoring missile launches or enemy communications. Space forces also provided detailed data on where key Iraqi forces, such as armor brigades, were garrisoned.

Once an armor force moved out from a known garrison, JSTARS detected its movement. Space and airborne SIGINT sensors searched for any communications that forewarned of the brigade’s destination and mission. The intelligence section at the Air Operations Center (AOC) could task a number of airborne assets, such as a Predator or P-3, to gain additional information. Using the staring video, analysts confirmed the brigade’s location and movement. AOC personnel passed the target coordinates and engagement instructions for AWACS to direct a strike with fighters or bombers.

ISR air platforms comprised just 72 of the 1873 total OIF aircraft and flew roughly 1,700 of the 39,100 sorties—or 4% of the total aircraft and sorties. Operating in isolation, each system had limited value. By linking their information at key command nodes with robust communication networks, the IRAQI FREEDOM air commander employed ISR assets as a “force multiplier” to focus the efforts of the remaining 96% of his forces. The layered ISR constellation enabled the remainder of the air component to conduct relevant and timely operations.

The layered ISR network, however, had limitations in OIF. First, while the degree of ISR integration with command and control and attack aircraft was unprecedented, gaps in information existed. These shortfalls ranged from incomplete intelligence updates, to the U.S. Marine Corps supporting attack through eastern Iraq, to battle damage assessment that failed to keep pace with operations. In addition, U.S. Navy carrier strike aircraft had inadequate information for integration with SOF units in northern Iraq and conventional forces in southern Iraq. ISR in OIF was selective and prioritized to meet the Joint Force Commander’s intent, but inadequate to support the wide scope of operations.

Second, ISR forces surged to provide U.S. commanders the number of sensors and orbits employed during OIF. This level of deployment can not be sustained continuously. As an example of the limited ISR forces, the USAF has 14 RC-135 aircraft—enough to sustain a single orbit in one theater with five deployed aircraft. U.S. military forces require additional and more capable ISR forces if they are to improve their awareness and knowledge in hot spots around the globe.

Global Hawk’s contribution to Layered ISR and Persistent Awareness

The Global Hawk unmanned aerial system (UAS) is a new system providing commanders with multiple sensors capable of covering an area for 24 hours or more. As such, it will integrate into the layered ISR network to enhance commanders’ persistent awareness requirements. Many warfighters are familiar with what Global Hawk has already provided as a developmental aircraft supporting OIF. Among its contributions, Global Hawk provided over 17,000 images, contributed to 55% of all time critical target engagements and found 40% of the Iraqi armor formations.

The operational Global Hawk will provide greater capabilities. The Block 20 will be equipped with an advanced EO/IR/radar sensor suite providing WAS and detailed, spot reconnaissance images with multiple sensors. The Block 20 synthetic aperture radar (SAR) range will be 50% greater than the developmental version. The radar also has a ground moving target indicator (GMTI) mode that detects objects as slow as 2.5 mph. The Block 30 will add a SIGINT sensor that will provide a WAS capability out to at least 300 miles. The Block 40 aircraft will be equipped with the

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b Current USAF planning factor often postulates 5 manned aircraft to sustain 1 orbit for a 24 hour period.

c Global Hawk will be fielded in a series of “blocks.” Block 10 is the initial operational aircraft with limited EO/IR/Radar sensors. Block 20 has an improved EO/IR/radar. Block 30 will add a signals collection sensor. Block 40 will have an advanced electronically scanned array radar.
Multi-Platform Radar Technology Insertion Program (or MP-RTIP) active electronically scanned array (AESA) radar. This radar will allow joint forces to simultaneously detect and track moving ground targets while continuing to use its SAR mode to produce detailed spot images. It will also have the ability to track dismounted targets with improved accuracy.

As a multi-sensor and long endurance platform, Global Hawk will assist commanders with sustained collection over a wide area while simultaneously producing precise target data. Global Hawk’s contributions to the layered ISR network are summarized in Figure 2-1. This chart reflects a snapshot of ISR capabilities in terms of orbits, WAS, discrete spot reconnaissance and precision target quality data that each system can produce.

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**Global Hawk at a Glance**

**Speed:**
310 – 340 KIAS

**Range/Endurance:**
Operates at 2,000 miles and on station 24 hours

**Payload:**
EO/IR/Radar IMINT/SIGINT/MOVINT

- **Wide Area Surveillance**
  - IMINT: 40,000 sq miles
  - SIGINT: 300+ mile range
  - MTI/MOVINT: 200 mile range over and 95 x 95 sq mile area per minute

- **Spot reconnaissance**
  - IMINT: 1,900 images per day with 1 foot accuracy
  - SIGINT: Yes
  - MTI/MOVINT: Yes

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### Figure 2-1: Summary of ISR sensors and capabilities.

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<tr>
<th>SIGINT</th>
<th>IMINT</th>
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**Notes on Figure**

1. Number assigned is derived from Military Balance, 2006
2. “Orbits” = number that can be operationally sustained based on the “one-third” rule: 1/3 of assets deployed, 1/3 preparing to deploy and 1/3 recovering from deployment.
3. “Time” = Mission duration
   - Green = 24 hours+
   - Yellow = 12-24 hours
4. WAS = Wide area surveillance
   - Green = Capable
   - Red = Not capable
5. Spot = Monitor discrete location or object
   - Green = Capable
   - Red = Not capable
6. Accuracy
   - Green = Precision guided munitions (PGM) quality
   - Yellow = less than PGM quality

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Persistent awareness, gained from a layered ISR network, is critical for U.S. military commanders to accomplish their missions. The previous section argued that a layered ISR system is essential to persistent awareness. Within that system, Global Hawk—with its long endurance, wide area coverage and robust sensor data—contributes significantly to meeting commanders’ persistent awareness needs. This section illustrates Global Hawk’s capabilities to support operational requirements in the two most stressful scenarios: major combat operations and the global war on terror. At the same time, this section postulates a fleet size required by commanders to fulfill their missions based on the QDR scenarios will define operational requirements for budgetary and programmatic decisions.

To support the analysis, three Global Hawks are used as the planning factor to sustain a single, 24-hour-a-day orbit at a range of 2,000 miles from an operating base. Figure 3-1 reflects a representative flight-maintenance schedule for two aircraft with a third aircraft as the available spare to support a single, continuous orbit. By comparison, USAF force planners often use a 5:1 ratio for manned aircraft to maintain a single continuous orbit.

**MAJOR COMBAT OPERATIONS**

Deterring and, if needed, fighting a traditional theater conflict will remain a high priority for Combatant Commander. A hypothetical conflict with Iran in the 2015 to 2020 timeframe will provide a framework for discussion.

First, with the retirement of the U-2 starting around 2010, the air component commander will employ Global Hawk as its replacement. In this manner, Global Hawk will be tasked to collect specific and discrete images against a list of requirements (or “deck”). During Operation IRAQI FREEDOM, 15 U-2 aircraft deployed and provided that capability. On a number of days, the air task order (ATO) tasked six U-2s during a single 24-hour period.11 No change is expected in this mission requirement.

Second, Global Hawk can be incorporated to extend the range and coverage of other sensors in the layered ISR network. While the RC-135 collects SIGINT out to 150 miles, Global Hawk’s airborne signals intelligence payload (ASIP) can extend that coverage to 300 miles. Overlapping SIGINT sensors will also allow military analysts to pinpoint an emitter’s location faster. The EO/IR sensor can image an emitter in addition to triangulating its location. Figures 3-2 and 3-3 reflect the RC-135 SIGINT coverage alone and expanded coverage with Global Hawk ASIP as a supporting element. To maximize the coverage, five Block 30 orbits (15 aircraft) would be required.
In a similar manner, the Block 40 Global Hawk with its advanced active electronically scanned array (AESA) GMTI radar can extend the area of the E-8 Joint STARS coverage. Current Joint STARS radar ranges to 150 miles. Operating higher, the Block 40 could range to 200 miles, but would have lesser quality information at the farther range. When flown in combination with Joint STARS, the E-8/Global Hawk pair can provide overlapping coverage to reduce gaps, such as when one aircraft turned in the orbit. Given the size of a conflict area similar to Iran, 5 Block 40 orbits (15 aircraft) would be warranted.
Based on current operational concepts, thirty Block 30 and fifteen Block 40 Global Hawks would provide the commander with improved persistent awareness from the layered ISR network.

GWOT

Commanders’ requirements for persistent awareness extend to counter-terrorism campaigns—operations distinct from major combat operations. As outlined in the QDR, the war on terror will drive additional force structure requirements. Global Hawk’s multiple sensors, coupled with its range and endurance, make it an important tool for commanders to gain persistent awareness in counterterrorism campaigns.

The Department of State’s annual report on terrorism provides a starting point for understanding where theater commanders must collect information as part of the GWOT campaign. This list highlights both known areas and ungoverned regions where terror networks can thrive. It is offered as a springboard for discussion to help define the combatant commanders’ requirements.

In U.S. Southern Command’s area of responsibility (AOR), the tri-border area between Argentina, Paraguay and Brazil is a concern as a terror haven. U.S. officials suspect $6 billion a year is laundered in this area, in addition to arms and drug trafficking. The region between Colombia, Venezuela, Ecuador, Peru, Panama and Brazil represents another area where the Revolutionary Armed Forces of Colombia (FARC) operate. In addition, President Chavez permits the FARC and other groups to operate from Venezuela.

In U.S. European Command’s AOR, multiple safe havens exist in Africa. In the Pan-Sahel area of the Trans-Sahara, the Salafist Group for Preaching and Combat (GSPC) recruits, raises funds, trains and conducts operations in the area around Mali and Mauritania. The GSPC has pledged support to al Qaeda and bin Laden. Further east, Somalia is home to a number of al Qaeda associated groups, such as al-Ittihad al-Islami (AIAI) and al-Takfir wal-Hijra. Bin Laden gained refuge in these lands during the 1990s. The harsh environs foster a strong Islamic fundamentalism that has become a political force in the region, providing fertile ground for Muslim extremists.

Along Africa’s northern border, the Mediterranean Sea is also a source of concern for USEUCOM. Since the Mediterranean Sea is a transit area for arms, money and personnel, NATO initiated Operation ACTIVE ENDEAVOR to monitor and intercept suspect shipping. Cyprus has served as a transit point for European and Middle East terror organizations. Further east, in the Caucasus, active terrorist organizations train and operate in places such as Chechnya, Dagestan, and Ossetia.

Problems in U.S. Central Command’s AOR are well understood—Lebanon, Syria, Iraq, Yemen, Iran, Afghanistan and its border with Pakistan. Further east in Asia, U.S. Pacific Command must deal with a significant number of ungoverned areas. The Sulawesi and Celebes Seas have been an area of concern between the Philippines, Indonesia and Malaysia. The Abu Sayyaf Group, Moro Islamic Liberation Front and Jemaah Islamiya (JI) have planned and conducted operations in the Philippines and Indonesia. Other areas, like Laos, Burma and Cambodia, are ripe for terrorist’s exploitation due to porous borders, limited police forces and drug trafficking that can fuel terror activities.

The map in Figure 3-6 highlights the 22 areas described above. If the U.S. intent is to keep terror leaders off-balance in addition to gaining persistent awareness, air-breathing ISR platforms provide theater commanders with an unpredictable watch over to terrorists’ activities. A second order consequence of persistent awareness is the threat of detection can actually alter terrorists’ activities. This threat and corresponding terrorists’ attempt to avoid detection can be almost as profound as removing terrorists from the international scene.

For persistent awareness, a theater commander will want to execute a minimum of two Global Hawk orbits each day. Fifteen of the 22 orbits, however, warrant daily coverage due to their active terror activities, resulting in a minimum deployed capability of 49 operational aircraft.
The analysis in this section offers a conservative calculation based on the missions assigned to the combatant commanders in two of the key challenges confronting the U.S.: winning a traditional conflict and defeating trans-national terrorists. It suggests that combatant commanders need at least 94 Global Hawk aircraft.

Figure 3-6: GWOT hot spots.
IV. Sizing the Fleet (2): Global Hawk’s Support to Maritime Domain Awareness, Missile Defense and Border Security

Section 3 examined illustrative Global Hawk support by reviewing two specific missions: major combat operations and the GWOT campaign. Additionally, Global Hawk’s capabilities can contribute to other persistent awareness requirements—such as maritime domain awareness, missile defense and border security. This section explores Global Hawk’s role and fleet size to support these critical missions.

Maritime Domain Awareness

Just as land forces require layered ISR to gain awareness of the battlespace, maritime forces have a similar requirement for the open ocean and littoral areas. The evolving security challenges of the 21st century have prompted the U.S. Navy to improve its maritime persistent awareness for multiple reasons. First, it needs persistent awareness for its common operating picture to support fleet operations. Second, such awareness is critical for the fleet to function as a “trip wire” force for the theater across the maritime commons. Third, it can support freedom of the seas activities while helping deter piracy. Finally, persistent awareness is critical to interdicting trans-national terrorists, including any attempt at transporting of WMD.

Denying terrorists access to maritime transportation and preventing the movement of WMD has been a U.S. priority for the past several years. In May 2003, the U.S. launched the Proliferation Security Initiative (PSI) with a host of global partners to deter and intercept WMD components moving along maritime routes. PSI’s centerpiece was improved situational awareness and intelligence of the maritime commons. In October 2005, the U.S. published its “National Plan to Achieve Maritime Domain Awareness” (MDA) to reinforce the PSI effort. This MDA plan articulated an ambitious goal to increase the ability to collect, fuse, analyze, disseminate and archive information on oceangoing ships, cargoes, crews and passengers. The core of the program will be a near real-time maritime common operating picture linking multiple sensors and databases to military command centers plus federal, state and local agencies.

Given the nature of the maritime environment, a single maritime ISR sortie can contribute data to all of these tasks—fleet protection, trip-wire, anti-piracy, GWOT and preventing WMD proliferation. The U.S. Navy relies on its maritime patrol aircraft as critical to its ability to conduct such overlapping tasks. Since its P-3 and EP-3 aircraft have decades of service, the Navy has launched a Maritime Patrol Reconnaissance Force Recapitalization plan. The Navy anticipates that its recapitalization plan will allow for open-ocean and littoral support 365 days a year.

This recapitalization plan relies on a three-pronged strategy. First, the new Multi-mission Maritime Aircraft (MMA) will provide the core future anti-submarine warfare sensors as well as being capable of anti-surface and ISR tasks. It will search, track and attack submarines in addition to detecting, tracking and classifying surface vessels. Second, the Navy is developing requirements for a joint multi-intelligence aircraft to replace the EP-3. Finally, a broad area maritime surveillance (BAMS) aircraft will provide persistent surveillance and fill the gap between MMA and EP-3 capabilities. The BAMS platform’s endurance will allow maritime commanders to detect, track and identify surface vessels and alert the fleet to specific ships or areas of interest for more detailed reconnaissance. The Navy anticipates deploying BAMS to support five Joint Force Maritime Component Commander (JFMCC) headquarters.
A modified Global Hawk offers a solution for this requirement. The BAMS Global Hawk will be based on experience gained from the existing Global Hawk program and platform, but will be engineered for the maritime environment and mission. As such, Global Hawk is a low risk solution. It will allow for operations at all flight altitudes with improved corrosion, fatigue and anti-icing capability.

The BAMS aircraft will provide the key sensors naval forces need to meet the national MDA objective. With an operating radius of 3,000 miles, it will provide wide area surveillance and specific, detailed data simultaneously. For surveillance, the LR-100 Electronic Support Measure (ESM) system will alert U.S. forces to key communications and other signals in a 360 degree circle out to 300 miles—covering nearly 7 million square miles during a 24 hour mission. The radar can search, detect, track and even classify vessels in all weather conditions. While its EO/IR sensors can cover 40,000 square miles each mission with 1 meter resolution, they can also discriminate targets out to at least 90 miles from the aircraft as shown in Figure 4-1. Thus, like its Joint Force Air Component Commander (JFACC) counter-part, the BAMS Global Hawk will give the Joint Force Maritime Component Commander (JFMCC) the dual ability to monitor a wide area while providing discrete data on specific locations or forces.

The BAMS Global Hawk, however, will not operate in isolation but will be fully integrated with the fleet’s network as part of a maritime layered ISR system. Its data can be transmitted via data link to the MMA P-8 and the rest of the Navy’s FORCEnet, providing both wide-area surveillance and the ability to extract specific reconnaissance data. The Mission Control Station will exploit some of the immediate data collected, but Global Hawk’s primary value will be to feed information to the Tactical Support Center with vital sensor feeds for the common operating picture.

The Navy plans to deploy BAMS aircraft to five fleets world-wide as depicted in Figure 4-2 in order to support combatant commanders’ requirements. Within a fleet’s area of responsibility, multiple areas of concerns will exist within the range of a single Global Hawk sortie, as Figure 4-3 indicates. Globally, there are at least 13 key shipping lanes and ports of concerns that warrant monitoring.

Figure 4-1: Global Hawk EO images at 115 miles.
These include ports on the east and west coasts of the United States, the Strait of Malacca, Gibraltar, Suez, Hormuz and the Red Sea. These are crucial areas for both commercial seafaring traffic and potential terror/WMD transit routes. Considering that two orbits were accounted for in the previous section, 11 orbits are unique to the MDA missions. This would drive a force structure of at least 33 Global Hawks and 5 operational spares for a total of 38 Global Hawk aircraft. These aircraft are in addition to the JFACC aircraft supporting GWOT and a major combat operation within a theater.

**MISSILE DEFENSE**

Over the past two decades, confronting the ballistic missile threat has emerged as a requirement for combatant commanders. In this arena, detecting and discriminating the warhead from decoys and debris is critical to enabling mid-course intercepts. The sooner the warhead is detected, the sooner the intercept can begin. The Space Tracking Surveillance System (STSS) will ultimately provide this capability, but it is not planned to be operational until 2019. As an interim capability, Global Hawk with an airborne IR sensor (ABIRS) can support missile defense.

The Global Hawk requires modification to perform this mission. Elements of the Integrated Sensor Suite (EO/IR/RADAR and ASIP payloads) would be removed to make room for a unique IR sensor capable of tracking a ballistic missile warhead. This sensor detects and tracks the ascending warhead post-boost phase, providing the forward Command and Control Battle Management node.
with critical data on the warhead’s path. For short-range ballistic missiles (SRBM) like SCUDS, the Global Hawk will need to be within 600 miles of the launch site. For medium-range or longer, the platform needs to be within 1,200 miles of the launch site.

Using the major theater war illustrative scenario for Iran, three Global Hawk BMD orbits would be necessary, with seven to eight total aircraft being required (assuming the aircraft are collocated at the same operating base) to support orbits shown in Figure 4-4. Two Mission Control Elements (MCE) are required to support this number of aircraft and orbits. It might be possible for a traditional, Block 20/30/40 Launch and Recovery Element (LRE) to launch the BMD Global Hawk, reducing the LRE requirement. Since more than one hostile nation is seeking ballistic missile capability with WMD and force planning guidance requires anticipating multiple, nearly simultaneous major combat operations, a second set of BMD Global Hawk would be prudent. This raises the missile defense fleet to at least 16 operational aircraft.

Border Security

In the fall of 2005, the Department of Homeland Security (DHS) announced the Secure Border Initiative (SBI). This initiative followed a series of efforts to improve the Customs and Border Patrol’s (CBP) ability to prevent terrorists and WMD from entering the U.S., in addition to reducing illegal immigration and interdicting criminal activity.26

DHS Secretary Michael Chertoff outlined his improved border security strategy with a multi-step campaign that included:

- Deploying more agents for physical presence and detailed investigations
- Expanding detention and removal capabilities
- Improving physical infrastructure along the border
- Increasing enforcement of immigration laws
- Employing advanced technologies (manned, unmanned, air and ground based) to help secure the border27

Surveying the borders is a difficult challenge. Since over 97% of illegal entry apprehensions occur along the southwest border, the CBP deploys over 90% of its agents to this area. The 4,000 mile U.S./Canada border, however, presents a unique set of surveillance issues. Given the border’s length, the remoteness of the terrain where individuals can cross in trucks, snowmobiles, boats or on foot, and Canada’s liberal immigration policies, terrorists north of the border enjoy sanctuary and a wealth of border crossing options. Ahmed Ressam, convicted of the Millennium bomb plot, and Abu Mezer, convicted of planning a suicide attack in New York City, both used Canada as a base for their planned attacks.28

DHS employs an integrated system of personnel, procedures and technology to accomplish its border security mission. Technological solutions can provide multiple tools—from wide area surveillance to detect where people, vehicles, or aircraft penetrate U.S. territory—to high resolution spot images that allow an agent to confirm an intrusion.29

As a result, CBP has a requirement for persistent awareness similar to that of military commanders.

Ground-based sensors can provide a technological solution; however, they have limitations. Previously, DHS placed more than 11,000 such sensors along the northern and southern borders, but high false alarm rates and battery failures made
that network unreliable. Aerostat balloons can provide the sensor a platform with endurance measured in months. High winds, however, reduce their operating times by up to 40%. In addition, aerostats are not easily moved—shifting a sensor fifty miles or more is not practical.

Global Hawk offers a solution for persistent awareness for border security. Its radar can detect moving trucks, vehicles and possibly even personnel crossing the border. Once an illegal entry is observed by DHS personnel, Global Hawk’s EO or IR sensor can zoom on its location. In addition, the Block 40’s advanced radar supports coherent change detection (CCD) processes, where the radar can pinpoint locations, paths, origins and destinations of persons crossing open terrain. Given Global Hawk’s speed, it can cover the Arizona/New Mexico border in 2 hours and 15 minutes with the area coverage depicted in Figure 4-5. Alternatively, it can cover the entire Arizona, New Mexico and Texas international land border in just over 5 hours. Likewise, a Global Hawk operating out of North Dakota could cover the northern border three times in a single mission.

Global Hawk’s flight characteristics (high altitude, speed, endurance and range) coupled with its sensor suite provide a versatile tool for persistent awareness and offer DHS officials a vital tool to help secure the nation’s borders.

Operationally, two Global Hawk missions per day along the northern border and one per day along the southern border would provide balanced coverage to complement DHS’ strategy of mixing personnel, procedures and technology. This requirement would generate a total fleet of nine operational aircraft, with a mix of Block 20/30 and Block 40. Operated by the Air National Guard, the force could support DHS operations under Title 32, while swinging to support military operations under Title 10 in a contingency.
V. Summary

The contemporary security environment presents the U.S. with a range of diverse challenges—conducting major combat operations, defeating transnational terrorists, preventing the spread of WMD and countering disruptive breakthroughs. A common factor in confronting these challenges is persistent awareness. Commanders gain this awareness from a layered ISR network that monitors a wide area while concurrently extracting detailed, target quality information. Global Hawk, with its long endurance and multiple sensors, provides commanders with a flexible ISR tool. Fielding the right-sized Global Hawk fleet will allow its qualities to be relevant and will meet the DoD guidance to have Combatant Commanders’ requirements create a more “demand-driven” acquisition process. 32

Table 5-1 summarizes the distribution of 157 operational Global Hawks needed to help commanders accomplish their missions. These numbers do not include the maintenance or training aircraft needed. In addition, attrition reserve aircraft are a separate requirement. DoD’s UAS reliability report postulates that mature medium and high altitude UAVs should achieve a flying safety rate on par with manned aircraft—1 or 2 aircraft accidents per 100,000 flying hours. 33 The GWOT and maritime missions could total over 300,000 hours each year, resulting in 3-6 additional aircraft per year required for attrition reserve.

Fiscal pressure will affect the size of the Global Hawk fleet, but operational requirements should bound it. Currently, the Air Force expects to purchase 54 aircraft and use those aircraft as a replacement for the U-2. A fleet of 54 Global Hawks, however, is roughly half the number required based on the analysis in this paper. 35 Procuring 50 percent of what the operational commanders require invites risk—where some missions are not accomplished. To accurately assess the risk, military force planners must articulate what missions will not be done. In the past, DoD managed risk by swinging ISR forces to a higher priority mission when a new contingency emerged. For example, weekly reconnaissance missions ceased and ISR forces re-deployed to support a major combat operation, such as Operation IRAQI FREEDOM. In the post-9/11 era, trans-national terror organizations and risk of WMD proliferation will continue as a national priority while the U.S. is engaged in a traditional theater conflict. Thus, “swinging” forces may not always be a prudent option.

Fielding insufficient forces will also perpetuate the stress to the ISR force structure. Since 1990, ISR forces have been continuously deployed to meet combatant commanders’ needs. Due to their high pace of operations, DoD labeled them as “LD/DH” or “low density/high demand” assets. This term reflects both their critical value to theater commanders and DoD’s under-investment. Former Secretary of Defense Rumsfeld captured what LD/HD meant to him when he said: “We bought too many of the things we didn’t need and we didn’t buy enough of the things we do need.” 36

Table 5-1: Summary of an illustrative Global Hawk fleet. 34

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<tr>
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<tr>
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<td>84</td>
<td>19</td>
<td>16</td>
<td>38</td>
</tr>
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The U.S. faces a multitude of unprecedented security challenges. U.S. leadership and military commanders need persistent awareness in order to focus the right elements of national power at the right time and in the right location. As the Air Force Chief of Staff declared, Global Hawk “is going to be, when we get them in the numbers we need, worth its weight in gold.” 37
Endnotes

5 QDR 2006, pp 3-4.
6 QDR 2006, page 36.
8 Grant, pp 15-16, 22.
12 QDR 2006, page 36.
15 Country Reports on Terrorism, pp 17-18.
17 Country Reports on Terrorism, pp 19-20.
18 Country Reports on Terrorism, pp 18-19, 63-65 and 74.
19 Locations justified for daily operations include all seven in CENTCOM’s AOR.
23 Prindle.
24 Prindle. The five fleet headquarters are 2nd Fleet, 3rd Fleet, 5th Fleet, 6th Fleet and 7th Fleet.
25 Operational requirement for 11 orbits with 5 fleets would be 3 aircraft per orbit with 1 spare per fleet, or 38 total. This operational number does not include additional aircraft for training, test or maintenance actions.
29 Dr. Peter Worch, Technologies for Border Security, Testimony before the House Committee on Science, September 13, 2006, page 2.
30 Worch, page 4.
34 BMD = Ballistic Missile Defense and BAMS = Broad Area Maritime Surveillance.
35 Of the 153-168 postulated in this paper, 100 would fill the “traditional” Air Force requirement; the other 53-68 aircraft support U.S. Navy and Missile Defense Agency requirements.
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