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Responsive Space and Strategic Information

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Overview

American strategists face a daunting challenge; they must assure and defend American and allied interests, induce and encourage international security cooperation, and deter, dissuade, and defeat a diverse range of potential adversaries. This challenge has been addressed by senior political leadership in recent policy statements, such as the Nuclear Posture Review of 2002, and in the formation of an expanded U.S. Strategic Command, but this vision has not yet taken root in the Department of Defense components responsible for providing operational capability.

We propose a new strategic posture based upon a war-prevention focus. The central element of our proposal is a transformational space and information sortie capability. American space capabilities now depend on a fixed infrastructure of large, expensive satellites. We argue for a complementary capability to launch small, inexpensive payloads in time of crisis to augment and reconstitute existing capabilities and perform entirely new special operation missions and global conventional strikes through space. These assets also would expand information operations beyond network defense and network attack to create effects in the minds of our adversaries and those who would support them.

An enabler for these new capabilities will be the technology to deliver effects in and through space rapidly and affordably. A similar capability will be needed to deliver effects through cyber space. Space-based nodes would be critical components of an integrated physical, cyber, and psychological application of military force and strategic influence. These technologies exist today both in the United States and elsewhere. But a focused and funded program to develop them for military purposes is not yet in place.

This new strategic posture will arguably require the formation of a new space and information military service to organize, train, and equip the space and information force structure of the future. The nucleus of such a new service exists today in the U.S. Strategic Command and its components.

Pick up any Department of Defense (DOD) document on strategy or organization and the terms *warfighting* and *support to the warfighter* stand out on page after page. Warfighting appears 11 times in the U.S. Air Force Space Command Strategic Master Plan.[1] War prevention and deterrence appear only in the context of nuclear weapons and nuclear war. The fact is, since the end of the Cold War the idea that military forces exist primarily to deter war and shape the peace has fallen out of fashion.

Yet, policy guidance calls for transformation across the board, not just in warfighting. The 2002 Nuclear Posture Review specifically mandates moving to new forms of deterrence and war prevention based on conventional capabilities and increased industrial base readiness.[2] Moreover, in 2002 the United States revitalized a joint combatant command, the U.S. Strategic Command (STRATCOM) in Omaha, Nebraska, to take on expanded global deterrent forces, including space, information operations, intelligence, surveillance, and reconnaissance (ISR), and long-range strike. Yet, the STRATCOM mission statement describes the purpose of space assets as being to "[p]rovide operational space support . . . to the joint warfighter."[3]

Contrary to recent policy guidance, DOD remains wedded to a warfighting mindset and unappreciative of deterrence, assurance, dissuasion, and other methods of ensuring national security. Why this limitation? What can be done about it? This paper addresses these questions.

Impediments to Change

The primary impediments to implementing a new space and information strategic posture for war prevention are:

- Lack of in-depth strategic analysis and thinking about preventing war in the new global environment.
- Lack of many of the necessary capabilities, particularly in space and information operations. A new set of tools must be developed to support strategic objectives in a responsive way.
- Organizational inertia. In particular, no military service is postured to train, organize, and equip for the new global war-prevention needs. The U.S. Air Force is the service charged with most of the responsibilities for providing

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military space capabilities, but its focus is decidedly on warfighting rather than war-prevention.[4]

New capabilities, thinking, and organizations are unlikely to evolve within the current service and command structure. It is time to consider revolutionary change embodied in a separate space and information service dedicated to global war-prevention strategies and capabilities. The remainder of this paper discusses directions a new service might take, capabilities it might seek to develop, and organizational constructs it could follow.

A New Strategic Approach

The United States is in transition from Cold War deterrence strategy to a new strategic posture. Before the terrorist attacks of September 11, 2001, most strategic analysis focused on the rise of one or more near-peer competitors. The generally accepted view was that the world was moving toward a multi-polar condition rather than returning to the bipolar circumstances of the Cold War. Unexpectedly, the global war on terrorism focused our attention on non-state, global threats. These new threats engendered new thinking on national security, but U.S. actions seem focused on warfighting as the principle means of eliminating emerging threats. In the case of terrorism, the military operations in Afghanistan in 2001–2002 represent our most direct action. The 2003 invasion of Iraq represented a preemptive military solution to the potential rise of a near-peer competitor armed with weapons of mass destruction (WMD).[5] Senior defense officials have recognized that the lack of suitable tools and strategies outside traditional warfighting approaches hampers our war on terrorism. Secretary of Defense Donald Rumsfeld has recently tasked his senior advisors to consider new solutions for such shortcomings.[6]

We do not mean to suggest that the U.S. Government has not approached the problems of terrorism and WMD proliferation on many fronts other than military action. Numerous efforts have been made to track down terrorists, cut off their resources, and prevent hostile states from acquiring the expertise and components needed to threaten the United States. Considerable progress has been made on defensive measures, such as missile defense and civil preparedness. Yet, little progress has been made on shaping the global situation to prevent threats from arising and to eliminate conditions for them to arise. This contrasts sharply with Cold War strategy that sought to contain the threat of communism while simultaneously working to expose its inconsistencies and reverse its virulent tendencies. A new strategy and the tools to pursue it are needed to address the threats we now face and the ones that might arise in the future.

While the current war on terrorism clearly has ideological aspects, we hold that conflict is always and foremost a conflict between minds. This is epitomized by the statement, "Machines don't fight wars, people do, and they use their minds."[7] Where the last century saw the development of maneuver warfare, emphasizing dominant maneuver in time and space, we now see the primacy of maneuver in command and control—essentially maneuver of the mind that extends beyond combat to the war of ideas.[8] The aim is to stay within an adversary's cycle—to move in the realm of ideas and actions faster than the adversary can react. Ideally, following the admonition of Sun Tzu, our objective is to win a conflict before combat begins.

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Responsive Operations

To envision how space and cyber space (and information in general) could enable new war-prevention strategies, consider possible future global security threats on three time scales: long-term (years to decades), mid-term (months to years), and short-term (minutes to days). Threats on each of these time scales are associated with different effects and require a different range of possible responses. The objective in each case is to provide the President with options and tools to manage and shape the global environment to lower the risk of war and increase the opportunities for people everywhere to enjoy free exchange of ideas and commerce.

Long-Term Responsiveness

Long-term threats fall into three categories. The first is the emergence of a nation or alliance hostile to U.S. national security interests and willing to use force to achieve its aims. This threat generally is referred to as a peer competitor, an adversary with roughly comparable military power, at least within is own region. The paradigm here is a return to the circumstances of the 20th century, when coalitions of totalitarian states imbued with doctrines of fascism and communism threatened the United States and like-minded nations with a virulent philosophy backed by formidable armed might. That situation, which prevailed for much of the 20th century, is one we would most hope to avoid.

The second category, which is related to the first, is the rise of virulent states, possibly as part of a larger coalition, armed with WMD (the canonical chemical, biological, radiological, and nuclear weapons, to which we would add cyber attacks). We add cyber threats to the growing potential of WMD to eliminate vital infrastructure, including basic services and potable water, because the loss of cyber utilities could unleash destructive effects on unprepared urban populations. While such enemies may not threaten the very existence of the United States or its way of life, they can cause considerable damage to the United States and allies and could form the nucleus out of which a peer competitor might grow.

The third category of threats comes from non-state actors who take advantage of the globally interlinked economy and society to attack the foundations of established polities. This threat came to the fore with the terrorist attacks of September 11, 2001. The non-state actors may have objectives ranging from local independence movements to globally dispersed groups, such as Al Qaeda. All seek to move within the freely flowing ideas, goods, and people necessary for a peaceful and just society, and all seek to use that freedom to disrupt the global community so that their political ambitions can be forced upon others.

A long-term strategy to address these emerging threats has many components. The fundamental long-term objective is to eliminate the circumstances that enable individuals, groups, or nations to use violence to further their objectives. There are some very central roles that space and information capabilities—managed by the U.S. military—can play in this strategy. First, we recognize that the global interlinked culture has at its heart a set of global utilities, such as the Internet, satellite communications, and the Global Positioning System (GPS). These mostly grew out of U.S. military initiatives and programs, their eventual public sector benefits being serendipitous, but such dual-use capabilities could be part of a coherent, cooperative strategy to shape the world situation. To do so we should embark on a coherent cooperative program to develop new global utilities, protect existing ones, and make use of all such utilities to prevent the rise of the threats outlined above.

We would like to emphasize a key feature in this strategy: that the U.S. pursue *cooperative* international arrangements. Traditionally the American national security apparatus has strenuously avoided international involvement in space and information endeavors. This is due in large part to the fact that these technologies have been at the heart of our intelligence collection activities and were considered too sensitive to share. Unfortunately, this go-it-alone policy has encouraged others to develop their own capabilities—most notably in imaging from space and global timing and positioning systems (such as GPS). Investing in bilateral and multilateral cooperation could pay dividends to our future security by improving capability, sharing cost, and allaying fears based on misperception of U.S. intentions.

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Developing new global utilities cooperatively might prevent the rise of hostile peer competitors. Conversely, refusal to cooperate might generate new animosities. Recent experience with the American GPS and the proposed European Galileo system, which has similar navigation and timing objectives, is a case in point; repeated U.S. rebuffs of European overtures, and insistence on an American-only policy for security reasons were significant factors in pushing the Europeans to build a competitive system. Cooperation in critical global utilities creates economic and military ties that can mitigate the rise of peer competitors and hostile actions by other entities. Moreover, it could save the American taxpayer money. One very exciting such program is a proposed small satellite development between the U.S. Air Force and the Chilean Air Force. This program, to be launched this decade, will provide valuable scientific data and critical national security support to both nations.

Another long-term function of cooperative military ventures is to protect the integrity of global utilities. The Internet is at the heart of current global economic development, yet it suffers repeated attacks by computer viruses and worms. A successful attack on the entire Internet could destroy the global economy and should be considered a form of WMD. Only the most rudimentary international cooperative venues exist for protecting the Internet. STRATCOM mounts one of the most effective computer network defense operations, but it is limited to the Defense Information Infrastructure. However, many of these military methods could be adapted for broader global defense of the Internet. More to the point, U.S. military infrastructure could form the basis for cooperative protection of these global utilities.

Similarly, we see increased threats to space infrastructure in the form of electronic interference and even threats to ground facilities. Protecting this critical infrastructure is one of the highest priority DOD missions in space control. Unfortunately, space control is seen by much of the world as a threatening, aggressive capability of the United States. Establishing international capabilities to protect the free use of space and deny it to aggressive entities could alleviate fears in the international community and gain acceptance for the necessary space control initiatives.

Perhaps the most significant use of new global information utilities is in their capability to attack the root cause of threats. This is particularly true of global terrorist threats. If the process by which a person becomes a terrorist can be well understood, it might be possible to interdict that process through various information tools. Terrorists develop among young disenfranchised populations, often within societies where access to global free flow of information is prevented by governmental, cultural, or religious authorities, and where they are barraged by extremist propaganda. If global sources of information can be brought to bear to provide potential terrorists free and open access to information, it is likely that most would-be terrorists could be diverted towards peaceful political alternatives for addressing grievances.

Means of delivering information, particularly through direct broadcast space systems, can be a most potent tool in a long-range strategy. Any new efforts to exploit the power of information and influence operations in support of national security will need to be well understood and supported, as they are becoming the most effective tools for ensuring national security in the future.[9] The need for a separate organization focused on these effects and capabilities is noted in Secretary Rumsfeld's charge to his senior advisors.[10]

Mid-Term Responsiveness

Space and information capabilities can enable the world to identify hostile preparations months or even years before they can be brought to bear. This is not a new mission. Indeed, the primary use of space capabilities during the Cold War was to provide early warning of hostile moves by the Soviet Union and its allies. In the new multipolar world, this information should be made public and readily accessible. In a world where economic activity is dominated by global utilities, negative world opinion can be translate to enormous economic pressure. In the past, economic embargoes and blockades were brought to bear and often produced results in the form of changed behaviors over relatively long periods. In the future, lack of access to such vital utilities as the Internet and GPS could bring an

economy to its knees in a few weeks. The loss of a single electronic pager satellite in the late 1990s had significant negative impacts on the North American economy.[11] With global utilities under a cooperative international arrangement, dictates from international fora such as the United Nations could be translated immediately into compelling economic action.

The most significant mid-term strategy would be to use control of global utilities to stop the rise of new threats. Both space and cyber space are principal channels for most global information flow. As most intelligence agencies already realize, information on the development of such threats as WMD can be obtained from cyber and space sources. Cooperative collection of information could actually strengthen our access to vital information about emerging threats, opening new avenues for access. Moreover, if critical data were gained in a cooperative manner it would be easier to convince allies of the seriousness of the threat.

In the past, the United States relied on the threat of escalation, first conventional and then nuclear, to keep crises from exploding. But these options both have drawbacks. A conventional military response typically requires a lengthy time of force deployment and buildup in the crisis region. An aggressor acting quickly may secure an objective before the United States could engage, thus raising the level of retaliation to undesirable levels. Crossing the nuclear threshold is such a drastic step that it is effectively reserved only for possible retaliation against the use of WMD against the United States. Thus, the ability to escalate in a rapid and measured way with space and information operations could be quite credible. Escalation could start with mid-term denial of access to global utilities. Even the threat of blocking access to global utilities could convince aggressors to step back from the brink during a crisis. This would require sortie access to space and cyberspace, as discussed below.

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Short-Term Responsiveness

On the timescale of minutes to days, space and information capabilities could become the most formidable tool in preventing crises from escalating. Should combat become necessary, these same capabilities could bring a conflict to a quick and satisfactory close. Should economic forms of deterrence fail, we must be ready to move to more forceful means. The mainstay of Cold War deterrence was that exploitation of a crisis risked unacceptable damage to the aggressor's society and military forces. The prospect of such damage alone was generally deemed sufficient to lead protagonists to step back from a crisis. Because of the inability of the United States credibly to threaten nuclear retaliation, and the immense cost, risk, and delay in bringing conventional forces to bear, an aggressor today can contemplate a long period to act free from interference by the United States or other stabilizing forces. Indeed, this view led Saddam Hussein to invade Kuwait, and it could lead a more formidably armed power to even more dangerous actions in the future. To deter such aggression, the United States must be able to respond to military movements in hours or days, vice months, and to respond in a credible, non-nuclear manner. Responsive space systems could provide an effective capability to interdict an aggressor's initial use of force before it grows into a large-scale military conflict.

The first objective in a crisis must be to greatly augment our ability to find, fix, and track the forces of potential adversaries. Today we rely on a mix of space-based sensors and airborne assets. The latter can take weeks to get into position, and the former currently cover only a small fraction of adversary forces and movements. An answer to these problems is to establish a continuous monitoring capability that covers a broad range of potential adversary indicators. However, putting in place a truly global satellite system covering many indicators continuously can be prohibitively expensive—many dozens of satellites would be needed for each type of sensor, such as space-based radar. However, a temporary capability based on reusable systems could be tailored for a particular crisis and region. The act of putting such sensors in place over a few days could itself send a strong message to an aggressor, since the sensors also can serve as precise targeting systems. The cost of such systems could be quite affordable, and the benefits could be enormous.

To be truly credible, a non-nuclear deterrent must have the ability to target, engage, and reassess the objective. With current military forces, assembling the ability to strike takes many weeks, and usually many months, and is expensive in terms of equipment and personnel. It also places many Americans in harm's way (which becomes a reverse deterrent where forward-deployed Americans are more of a hostage than a threat). Finally, it requires forward basing of forces, which allies must be induced to support.

To deter or fight a war, the United States needs the means to strike decisively and credibly in hours to days without forward bases. The use of long-range kinetic strike forces based at great distances, together with credible cyber strike options, could fill this requirement. The total numbers of critical adversary facilities that need to be defeated could be relatively small—perhaps as few as several hundred. Combining cyber attack with long-range, precision kinetic attack would minimize potential collateral damage and thereby make U.S. deterrence even more credible.

Tools for the New Strategy

The military term for the application of specific capabilities is *concept of operations*, or CONOPS. An appropriate CONOPS is needed to develop and employ any national security capability. To support the full range of capabilities, from war prevention to warfighting, we will have to explore new CONOPS and push new technological innovations. A more responsive space force structure is needed, one that is flexible in effects, rapid in time, and affordable in cost—one that is built on the familiar military concept of sortie capability.

Sortie Space CONOPS

Current space forces are infrastructure in earth orbit. Over the years, primarily driven by the high cost and schedule inflexibility of launch systems, the United States has packed satellites with more and more capability and designed them to last longer on orbit. This in turn leads to larger spacecraft, requiring larger launch vehicles, costing more money, and taking more time to deploy on orbit. This is not a bad model for many services delivered through space; ISR, communications, and timing and navigation information can be reliably delivered in bulk at an affordable cost. Services delivered from space by these means have become a critical and irreplaceable part of commerce, scientific exploration, intelligence, and warfighting capability.

But this approach has limitations. Scheduled time on ISR assets is highly sought after, and many targets of interest are not collected. The overflight by ISR assets on orbit can be plotted by adversaries, which undermines their effectiveness as collectors. ISR and communications often are deployed to provide global coverage that can be locally insufficient in a crisis. More importantly, infrastructure in space is vulnerable to attack and denial of services. Not many nations around the world now have this capability, but the technical sophistication to exploit inherent vulnerabilities is becoming increasingly available around the world. Even worse, we have essentially no capability to reconstitute damaged satellites on time scales shorter than years.

Sortie operations would focus capability on geographic regions during critical periods rather than provide global coverage. We will need to conceive of capabilities that optimize coverage and effect over limited areas. Satellite constellations probably would be tailored to optimize either coverage of or proximity to a region. Payloads may be self-sufficient or networked with other land, sea, air, or space sensors. In some cases, large satellite functionality could be achieved by a cluster of small satellites acting in concert. Satellites may need to be highly maneuverable, meaning that mission operations will need to be flexible and maneuverable, requiring sophisticated autonomous operations or sophisticated operations planning and command and control in operations centers. Additionally, in accordance with the evolving net-centric approach to military operations, these space-based assets will need to be designed and operated in a manner complementary to surface and airborne assets. Developers of new responsive space systems will need to work closely with specialists from other disciplines to ensure effective strategic and theater joint force operations

Most discussions of space capabilities, particularly weapons, assume that all capabilities would be stationed permanently in space. This has several disadvantages. As noted earlier, a very large and presumably expensive constellation of satellites is needed to provide the truly global coverage necessary to address the full range of possible threats. Moreover, once satellites are on orbit, an adversary has the advantage of being able to study and access the system at will and devise counter-measures. In addition, the presence of relatively easily tracked objects in space could invite preemptive attack and thus prove destabilizing.

To implement some of these new capabilities, important policy issues must be addressed. There is growing international and even domestic opposition to weapons in space. In these days of GPS-guided munitions and satellite-delivered information operations, exactly when a device is part of a weapon system and exactly when it is in space are ambiguous; a sortie strategy could mitigate many of these concerns, in that the weapons need not be stationed in space at all. Along with kinetic systems, information operations will need to become more sophisticated. Strategic forces will need to engage in information operations on the battlefield to counter anti-U.S. propaganda and to challenge hostile ideologies. These operations will need to be coordinated with other agencies involved in foreign policy to assure they are effective and appropriate.

A sortie strategy for short-, mid- and long-term strategic effects relies on responsive access to space. *Responsive* means not just quick launch but also flexible capabilities. This means that a capability—sensor, weapon, or command and control—would be largely maintained on the ground until needed. Upon request from the President for options in a crisis or to respond to an adversary's move, STRATCOM would prepare an option to fit particular requirements. Upon approval of the President, the capabilities would be sortied into space. For example, if we were responding to indications of an aggressor's troop movement, we might launch a set of 10–15 sensors tailored to the mission.

Since these sensors do not need to be everywhere continuously, the total inventory of satellites would be half that needed for a full-global-coverage constellation. Moreover, appropriately designed satellites initially could be launched into orbits that did not overfly the aggressor nation. Adjusting the constellation to provide more or less coverage could be a tool for managing a crisis. In a deteriorating situation, satellites could be moved to new orbits for better coverage, or satellites could be sortied to supplement those already in orbit. Should the situation improve, satellites could be moved out of overflight paths or even de-orbited to reduce tensions.

Weapons also can be sortied. Indeed, it would appear that the most cost-effective, long-range strike weapons would not be based in space, but rather maintained in readiness on long-range, rapid-response rockets in the United States or at a safe distance from the theater of operations. Basing weapons outside the United States might be less likely to invite responses against U.S. territory. However, systems must be based far enough from adversary territory so that they can be safeguarded against preemptive attack. Since numerous nations maintain long-range, conventional strike on ballistic missiles, a similar American capability would not represent space weaponization or arms race escalation. The only reason to base weapons in space might be to provide very-short-term weapon access (minutes vice the tens of minutes inherent in ballistic missile strike). The latter is only doable with directed energy weapons, such as lasers. The technology for direct energy laser strikes from space is not yet mature and could itself be considered for a short-term sortie into space. An alternative is to keep the laser weapon on or near the earth's surface and use mirrors in space to relay the beam to its target.

Sortie capabilities are especially needed to meet the rapid response strategy of achieving effective control of space within a few days, conducting precision global strike within a few hours, and being able to tailor ISR assets within a few days. These capabilities might be viewed as extensions of our current air superiority strategy within a

specific theater of operations with similar time scales. The difference is that what we used to be able to accomplish in a small area we might accomplish regionally (possibly globally) within similar time scales. Similarly, we would need to be able to perform ISR, control, and strike operations throughout cyberspace. However, given the speed at which things happen in cyberspace, the sortie function would need to be accomplished in seconds or minutes, not hours or days.

Technology Development

Key to a space- and information-oriented strategy is the technology for sorties into space. This consists of many elements: affordable access to (and probably from) space, fast reaction ISR payloads in space, space control payloads in space, long-range strike, and information operations. Technologists will have to explore how smaller payloads can be deployed rapidly to achieve useful effects. Initially, we should explore how such systems can augment and reconstitute existing capabilities: imagery of force deployments, weapons facilities, critical infrastructure, terrorist training camps and strongholds, signals collection for intelligence and targeting, additional communications channels, and timing signals for navigation and munitions delivery. But eventually, we will need to explore how these systems enable new capabilities: space-based space control missions, delivery of sensors through space to the theater of operations, and delivery through space of strike weapons.

The first, but by no means only, requirement is for rapid, affordable access to space. Affordability may be the most critical, because no strategy that requires very expensive individual elements is likely to withstand adversary efforts to proliferate beyond the scope of the strategy. For the past decade and more, the cost of both access to space and payloads has risen far faster than the cost of other military capabilities. It is a considerable technical challenge to reverse this trend while producing new, responsive, space access systems.

Launch Vehicles Responsive space access itself does not seem to require new technology. The intercontinental ballistic missile (ICBM) developed four decades ago is very responsive. Indeed, the Russians and the United States have adapted surplus ICBMs to provide occasional rapid access to space. Moreover, the Russian Zenit booster was designed in the 1980s to provide rapid, unattended space access for even large payloads using a fully automatic fueling and launch system. But ICBM systems are high-performance systems capable of launching within a moment's notice, and they are relatively expensive systems for small satellite missions ($20 million and higher).[12] Here, again, the challenge is to make access not only rapid but also affordable. The right approach is to start small and build up, much as our original space access systems were developed in the 1950s. This requires innovation within a development and experimentation program characterized by an incremental build-and-test flight-test program. In this phase, engineering and operational expertise will be needed. Adequate but reasonable funding will need to be devoted to experimental and developmental activities outside the constraints of the current system acquisition approach.

In 2003, the U.S. Air Force, in concert with the Defense Advanced Research Projects Agency (DARPA), began a program called Operationally Responsive Spacelaunch (ORS). The ORS program is designed to produce a low-cost, rapid-response booster capable of putting small (100–1000 kilogram) payloads into space for a total launch cost less than $5 million by 2007. A wide variety of concepts is emerging as of this writing. Many of the most creative and promising launch concepts are the products of new entrants into the launch business. Several concepts could even show results by early 2004. Some of these have been the result of wholly private funding. The most important result of this initiative will be to enable launch of microsatellites weighing 100kg or less within a few hours of call-up at a launch cost below $6 million. The significance of these systems to space control and tailored ISR is discussed further below.

Of course, many payloads cannot be reduced to 100kg. Some, such as communications satellites, must operate in geostationary orbits almost 36,000 km above the earth. Others require very large antennas and power supplies. These larger satellites are carried by the new evolved expendable launch vehicle (EELV) boosters produced by aerospace giants Lockheed-Martin and Boeing. But these boosters are neither cheap (they cost well over $100M to build and launch) nor responsive (they need many months of preparation before launch). Thus, we must consider how to place larger payloads into space cheaply and responsively.

The Air Force Space Command is completing an analysis of alternatives that indicates that reusable rocket technology can meet goals for a medium-size launch vehicle capable of placing more than 10,000 kg in orbit. Reusable launch vehicles have been the dream of space experts since almost the beginning of the space age, but the many efforts to produce such vehicles have failed. Technology does advance, however, and by the end of this decade we could produce a partially reusable launch vehicle that could place about 5000 kg into low earth orbit for about $20 million per launch—a factor of five improvement over a similar EELV. A reusable first stage vehicle with an expendable upper stage now seems quite feasible and would avoid the difficult technical challenge of high-performance, thermal protection systems needed for a reusable upper stage to survive reentry. This development could be followed by fully reusable systems operational in the middle of the next decade that would affordably and responsively meet most of our launch needs, with only the heaviest payloads requiring the large, expensive EELV.

Payloads But getting to space affordably and responsively is only the first part of the problem. We also need to develop payloads that are both affordable and capable of performing their mission in a matter of minutes after launch. It does no good to get to space in an hour if it takes, as it often does today, two months to safely activate the satellite. As with launch, our strategy is to start small with microsatellites. Modern technology, especially computer technology, enables a microsatellite weighing less than 100 kilograms to perform many of the same functions of older satellites weighing thousands of kilograms. Interestingly, low-cost microsatellite capability has been furthest advanced outside the United States, particularly in the United Kingdom and in Israel. Perhaps the leading experts in microsatellite technology in the world are at the University of Surrey Space Centre in the United Kingdom. Having produced over 25 working microsatellites, both they and the Israelis have shown that systems weighing in the 100–200 kilogram range can produce earth imaging performance better than one meter resolution—clearly within the range of meaningful military performance.

Microsatellites show great promise for both quick-response ISR and critical space control missions, such as space situation awareness. For example, the Canadian Space Agency launched a scientific satellite in 2003 weighing about 60 kilograms that can produce space surveillance data comparable to the U.S. space-based surveillance sensor on the 3000 kilogram MSX satellite now operated by DOD. Some U.S. agencies have begun developing quick response microsatellite programs. Perhaps the most significant near-term effort is a program jointly sponsored by the DOD Office of Force Transformation and the Air Force Space Command Office of Transformation and Development. To be launched in early 2004 on a new commercial booster costing less than $6 million per launch, a 100-kilogram microsatellite will locate and report electronic emitter data directly to deployed field commanders.

Although small satellites and microsatellites can do much, they cannot perform all of the necessary missions. Larger satellites will continue to be needed for such functions as space-based radar and communications. These programs today are not responsive, taking many years to develop and many months to launch and checkout. Efforts have yet to be started to make these systems responsive. However, the basic technology to do so is under development. For example, DARPA has a program called Orbital Express that will enable a system to be re-fueled or re-configured on orbit. As an alternative to responsive launch, moving or re-configuring satellites on orbit represents another approach to obtaining responsive space capabilities.

Rapid Global Strike As mentioned above, basing global strike assets on the ground and outside direct U.S. territory could be key to an effective non-nuclear space- and information-oriented deterrent. Such capability is now being developed under the collaborative DARPA and Air Force FALCON program.[13] It consists of the ORS launcher development cited above (which may be used to launch microsatellites into orbit or loft long-range strike weapons thousands of kilometers) and a device called the Common Aero Vehicle (CAV). The CAV is a hypersonic glider with up to global range that can carry 1000 pounds of munitions or sensors. The munitions could consist of penetrating conventional warheads, small smart bombs, or other precision munitions. Traveling at mach 10–15, the CAV can maneuver to avoid overflying sensitive areas and still strike within 90 minutes anywhere on the planet. To be tested in 2005–2007 timeframe, the CAV will provide the United States truly global rapid conventional precision strike without the necessity of forward based elements. With technology advances, the CAV could be launched in larger numbers on a single booster of the reusable class mentioned earlier or be carried on a hypersonic global carrier vehicle that also is being researched by DARPA.[14]

Global Information Tools One of the most exciting global information tools is commercially developed direct broadcast radios, which receive signals directly from satellites and are thus difficult to jam. Already in use in the global war on terrorism, these small radios, when distributed to target audiences, can provide direct access to global information sources. Information technology, particularly wireless technology, can also help, as it also can send and receive information through space links free from local interference or control. Coupled with dramatic advances in automatic translation software, this technology promises us the ability to directly link isolated audiences, those in which terrorist philosophies flourish, with information and ideas from alternative sources from around the world. If we can accomplish this, it will become far more difficult for terrorist philosophies to attract adherents. However, these technologies, as well as more intrusive ones making it possible to identify and isolate terrorist activity, are controversial. The DOD Office of Strategic Influence, which focused on direct broadcast radio and satellite-delivered Internet technologies, was quickly disestablished after inaccurate allegations of planned disinformation operations appeared in the press. Similarly, DARPA efforts to use the Internet to identify and root out terrorist activities in its Total Information Awareness program have been stopped. Nonetheless, these new technologies will be needed if we are to achieve national security objectives.

Organization

The establishment of the new Strategic Command in Omaha, Nebraska, was a big step in the coherent use of space and information capabilities. But STRATCOM, as a combatant command, does not control the resources necessary to develop new capabilities. Another big step was made in 2002 to coherently pursue strategic space capabilities. Based on the 2000 Rumsfeld Commission report recommendation, all Air Force and National Reconnaissance Office space acquisition was placed under a single office, the Under Secretary of the Air Force. Moreover, Air Force space acquisition activities were moved under the operational Air Force Space Command. However, space budgets within the Air Force are still traded for other Air Force priorities, such as new fighters and command and control aircraft. Crucial space science and technology programs and funding for certain other space activities remain outside Air Force Space Command purview.

The traditional military space establishment views investing in a new approach to military space capabilities as a risky and uncertain proposition. Moreover, the critical information operations piece of a coherent future strategy does not even have an assigned service to train, organize, and equip our operational forces in this area. Most development today is fragmented under a number of defense agencies including DARPA, the National Security Agency, and the Defense Information Services Agency. Even within the Air Force, where all space and information operations are supposed to support STRATCOM, the Air Force Space Command does not have responsibility for information operations. The latter has been retained by the Air Combat Command. These problems result in little coherent movement toward supporting the intent in forming a new Air Force Space Command or STRATCOM.

The Rumsfeld Commission noted the problems in developing new space capabilities and identified that at some future date all space activities, including the train, organize and equip function, should be under a separate military service. The commission suggested the first step is to form such a Service as a Space Corps within the Department of the Air Force, much as the Marine Corps is part of the Department of the Navy. The time for that move may be now. Independent services generally are needed when there is a class of security problems for which a single set of capabilities can best solve the situation independent of other services and capabilities. Warfighting solutions have become so complicated and interconnected that the efforts of all services are needed jointly. However, this

now means that all services are focused on warfighting solutions. To restore the focus on war prevention, a separate entity may needed. A new Space and Information Corps could be just that solution. It is particularly important that space and information responsibilities be included under such an organization.

One must also consider the programmatic approach to acquiring new space and information systems. While developing these new space capabilities is technically feasible, it will not be achieved without innovation and determination. Considering the current problems in the aerospace industry in acquiring new space systems in a cost-effective and timely manner, as described in the recent Congressionally-chartered Aerospace Commission report and the DOD-sponsored Defense Science Board report, some have suggested that it is premature to embark on new, transformational space development programs.[15] We contend that this is exactly the wrong approach. Putting the future on hold while fixating on current programs will mean our abandonment of the high ground of space as other nations vigorously pursue space capability. Conversely, we argue that a creative and reasonable responsive space development program will become the incubator where we relearn how to successfully develop, acquire, and operate space systems of the future—large and small, affordable and effective—whether they are traditional space infrastructure or revolutionary mission sorties.

Conclusion

The growing threats facing the United States and allies demand new approaches. The threats include the rise of new peer competitors, proliferation of WMD, and non-state, global terrorism. A new set of capabilities is needed that would focus on war prevention. Key among these capabilities are responsive space and information tools.

Much of the necessary groundwork for a new approach has been laid. The formation of a new U.S. Strategic Command provides an operational focus for war-prevention operations. The partial separation of space efforts from other capabilities within DOD has been accomplished under the Air Force Space Command and Under Secretary of the Air Force. Key technology developments, particularly in low-cost, rapid access to space, long-range strike, and microsatellites has begun, primarily within defense agencies, such as DARPA.

There remains much to do. Organizational inertia within existing warfighting-focused organizations remains an impediment. Public angst over new forms of military conflict and activities such as space weaponry, space control, and Internet operations will need to be considered. New CONOPS and new technologies will need to be developed to enable the responsive space sortie capability. Consequently, it may be time to separate these critical functions into a new Space and Information Corps with sole responsibility for training, organizing and equipping the forces necessary to carry out a crucial piece of 21st century security.

Notes

[1] Air Force Space Command, "Strategic Master Plan FY04 and Beyond," accessed at <http://www.the memoryhole.org/mil/space-command-plan-fy2004.pdf>.

[2] Department of Defense, Special Briefing on the Nuclear Posture Review, January 9, 2002, accessed at <http://www.defenselink.mil/news/jan2002/t01092002_t0109npr.html>.

[3] U.S. Strategic Command, "U.S. Strategic Command SNAP SHOT: A Summary of Facts and Information Representative of USSTRATCOM, January 2004, accessed at <http://www.stratcom.af.mil/factsheetshtml/SnapShot.doc>.

[4] General John P. Jumper, USAF, interview by Jeremy Singer, in "Space as a Means Not an End in Itself," *Space News*, July 14, 2003. Jumper wisely admonishes military thinkers to focus on effects rather than systems, but his remarks imply space capabilities be relegated only to "put a cursor over the target."

[5] George W. Bush, "Radio Address by the President to the Nation," September 14, 2002, accessed at <http://www.whitehouse.gov/news/releases/2002/09/20020914.html>. President Bush discussed the growing danger posed by Iraq: "By supporting terrorist groups, repressing its own people and pursuing weapons of mass destruction in defiance of a decade of U.N. resolutions, Saddam Hussein's regime has proven itself a grave and gathering danger."

[6] Dave Moniz and Tom Suitieri, "After grim Rumsfeld memo, White House supports him", *USA Today*, October 22, 2003.

[7] Statement by Colonel John Boyd, USAF (1927–1997). Boyd was one of the most seminal thinkers in the last century on the subject on strategies of conflict. His ideas originally focused on military conflict, but he later generalized them to cover conflict in a broader sense. Unfortunately, he did not publish any of his work. The materials he used in presentations have been copied, and former students and adherents have further developed his ideas. A biography by Robert Coram, *Boyd: the Fighter Pilot Who Changed the Art of War* (Boston: Little, Brown and Company, 2002), provides an introduction to his theories. An exposition on his theories and their applications is available in G.T. Hammond, *The Mind of War: John Boyd and American Security* (Washington, DC: Smithsonian Institute Press, 2001).

[8] John Boyd introduced the observe-orient-decide-act cycle, or OODA loop, in his presentation on patterns of conflict presentation in 1986. Digitized copies can be accessed at <http://www.d-n-i.net/boyd/pdf/poc.pdf>. Also, Thomas C. Schelling, *The Strategy of Conflict* (Boston: Harvard University Press, 1960), provided a lucid and insightful exposition of traditional theory. The traditional approach is essentially static, seeking a strategy (or series or moves) that can be played out serially once the game is engaged. Boyd argued that achieving a winning position only motivates an adversary to pursue new strategies. Consequently, we must be prepared to change our strategy at least one step in advance of an adversary's adaptation.

[9] Information and influence operations were primary methods of the Office of the Secretary of Defense Office of Strategic Influence, which was formed shortly after the September 11, 2002, terrorist attacks. Initial efforts by that office were undermined by critics who misunderstood its role, leading to its disestablishment less than 6 months after its formation. One of the authors was the director of the office.

[10] Moniz and Suitieri.

[11] "Wayward Satellite Wrecks Havoc," Reuters, May 20, 1998, accessed at <http://www.wired.com/news/technology/0,1282,12414,00.html>.

[12] Jeff Foust, "Operationally Responsive Spacelift: A Solution Seeking a Problem?" *The Space Review*, October 13, 2003, accessed at <http://www.thespacereview.com/article/52/1>.

[13] Defense Advanced Research Projects Agency, Special Notice (SN03–23), FALCON Program Broad Area Announcement, accessed at <http://www.darpa.mil/baa/SN03-23.htm>.

[14] Ibid.

[15] Defense Science Board/Air Force Scientific Advisory Board Joint Task Force Report, "Acquisition of National Security Programs," May 2003

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