# Space-Based Global Strike:

## Understanding Strategic and Military Implications

Larry G. Sills, USAF

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by
Larry G. Sills, Lieutenant Colonel, USAF

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## About the Author

Lieutenant Colonel Larry G. Sills is a 1978 Distinguished Graduate of Air Force ROTC from Mississippi State University. After pilot training, he spent the first 10 years of his career as a fighter pilot accumulating over 2,100 hours in the A-10, OA-37, and F-16 aircraft. In 1991, he graduated from the Air Force Institute of Technology with a M.S. degree in Engineering Physics, was assigned to the National Air Intelligence Center at Wright Patterson AFB, and then was assigned to the Seventh Air Force staff in Osan AB, Korea in 1994 where he served as a Combat Operations Officer. From there he was transferred to Eglin AFB, Florida, to become an Electronic Combat Test Director within the 53d Wing of Air Combat Command's Air Warfare Center. While at Eglin he served as the Director of Operations and then Commander of the 68th Test Support Squadron. His last position before beginning his current assignment was as the Deputy Group Commander of the 53d Electronic Warfare Group at Eglin. A graduate of the Air War College, Lieutenant Colonel Sills conducted this research under the auspices of the Center. His current assignment is the Deputy Director for Political-Military Relations and Human Affairs in the J-5 Directorate of the U.S. Southern Command.

## Preface

The purpose of this study is to examine the concept of prompt space-based global strikes. In order to contribute to the debate about its potential benefits and problems, this study addresses the effects of cultural mindsets and institutional preferences on decisions about future military strategy and forces. It examines how prompt precision strikes through space could provide an important set of options in future crises that are beyond the capabilities of current U.S. military forces. Finally, this study raises questions that the U.S. Air Force must consider about the future of aerospace missions.

In conducting this study, I am indebted to Dr. Grant Hammond and Colonel Ted Hailes, USAF (Ret.), for their enthusiasm and guidance, in particular the support that Colonel Hailes provided during the formulation of these ideas. In addition, I am grateful to my fellow Air War College students in the Research Seminar on Strategy and Technology, for their invaluable critiques of my research. I also would like to express my gratitude to the Air Force Research Laboratory for its support of my research trips to the Air Force Space Command and United States Space Command at Peterson AFB, Colorado, and to the Air Armament Center, Eglin AFB, Florida. Finally, I am indebted to retired Generals John A. Shaud and Joseph W. Ashy, and to many others, who discussed these issues with me. That being said, the author alone is responsible for the arguments presented in this study.

## Abstract

The Air Force and U.S. Space Command have developed long-range plans for demonstrating the value of technologies that give the United States the ability to execute prompt global strikes with precision conventional weapons through space. Such strikes could be launched from the United States to any point on the earth in less than 90 minutes. While the space operations vehicle is postulated as one potential delivery vehicle for this mission, and perhaps as early as the decade beginning in the year 2010, an alternative concept is to use ballistic missiles armed with conventional warheads to provide this capability. Since many states will have the ability to use weapons of mass destruction in the future, this study discusses the benefits and drawbacks of a capability for conducting prompt space-based global strike with conventional ballistic missiles and space operations vehicles. It also considers some of the political and military factors that could influence decisions to acquire, deploy, and employ this capability, with particular emphasis on the role of the U.S. Air Force. Thus, this study examines the military value of space-based global strike with long-range ballistic missiles and reusable launch vehicles that carry precision guided conventional payloads, considers the advantages and disadvantages of global strike from the U.S. homeland, and addresses the implications of a world in which the United States could conduct space-based global strikes.

# I. Introduction

In the book *The Masks of War*, Carl Builder argued that each of the U.S. military services has unique institutional cultures and styles that define not only who they are, but strongly determine their preferences.[1] These mindsets shape how senior military leaders view operational issues, yet also inhibit changing institutional thinking. One historical example was maintaining horse mounted cavalry in the armies of many countries, including the U.S. Army, long after it had become obsolete.[2] Another was the Navy's reluctance in 1868 to accept its first steam vessel, the *Wampanoag*, despite superb test results, because steam-powered ships were contrary to the sail-bound mindset of naval officers.[3] Although the Air Force is the youngest service, it was born with one of the strongest mindsets of all—independent application of air power. The Army Air Force struggled to be free of its parent with the zeal of a teenager longing for self-identity and independence from home. Strategic bombardment, in one form or another, has been the dominant theme for the Air Force since its inception. But, more subtly, Air Force culture has been strongly influenced by "the Icarus Syndrome"—its love of *airplanes* rather than *airpower*.[4]

### The Air Force and Ballistic Missile Development

The case of ballistic missiles strongly reinforces this conclusion. By the end of World War II, the consensus in the U.S. Army-Air Forces was that jet-powered airplanes were the next step in the evolution of airpower. But there were other airpower tools that emerged from World War II, notably the German V-1 cruise missile and V-2 ballistic missile.[5] In 1945, the Army Air Forces Commander, General H. H. Arnold, forecasted the need "to be ready with a weapon of the general type of the German V-2 rocket, having greatly improved range and precision, and launched from great distances" because improved antiaircraft defenses would make strikes with manned aircraft "impracticable."[6] In general, General Arnold's vision focused on the practical military potential of ballistic missiles.[7]

However, the Air Force believed that missiles would remain subordinate to manned jet aircraft. In fact, during the late 1940s and early 1950s the Air Force moved slowly to develop missile technology, while the Army and Navy immediately began to explore their potential.[8] The Air Force throughout this period agreed that ballistic missiles had such potentially great importance that these were the weapons of the future. Further, the Air Force consistently claimed that the obvious choice was to develop and employ these weapons, and that its research and development efforts into ballistic missiles made parallel efforts by the other services unnecessary. While the Air Force gained control of the development of long-range ballistic missiles, it essentially ignored the value of this weapon.[9] But what the Air Force was unwilling to conduct on its own was mandated by civilian authority and validated by the Commander in Chief,[10] largely because the Air Force was blinded to the potential of ballistic missiles and the expansion of airpower by the potential offered by manned aircraft.[11]

A central question is whether the Air Force is subject to the syndrome that limits its ability to see beyond its cultural inheritance. Although military officials often believe they are entirely objective and logical, there are several contemporary cases, which suggest that the Icarus Syndrome still influences Air Force thinking and could do so for the foreseeable future. These cases are designed to illustrate how current Air Force projects and thinking tend to reveal an institutional preference for manned aircraft.

*Unmanned Combat Air Vehicles (UCAV).* The Defense Advanced Research Projects Agency (DARPA) and the Air Force have funded an advanced technology demonstration (ATD) of an unmanned combat air vehicle that is designed specifically for high-risk missions, such as the suppression of enemy air defenses (SEAD).[12] The UCAV will have great advantages over manned aircraft. It will require less maintenance because there will be no need to fly sorties in order to maintain pilot proficiency.[13] There is also no need for a cockpit, ejection seat, or other life support functions, and since there is no reason to worry about g-induced loss of pilot consciousness, the vehicle can be designed for much greater range, maneuverability, and g-forces than a pilot could stand.[14] And there is the advantage of not having to put pilots at risk. The UCAV is a logical step in the development of air power and could enter the Air Force inventory in the next decade if the concept proves to be beneficial operationally.[15]

However, the UCAV concept is an airplane without a pilot on board. Although it is likely to cost significantly less to operate and support than current manned fighters, the concept of operations will be similar to manned fighter/attack aircraft. While this seemingly futuristic airpower concept represents a significant improvement in affordability if not in capability, the UCAV is an evolutionary projection of the *status quo* in aerospace power.

*Long-Range Airpower.* In 1997 the congressionally directed Independent Bomber Force Review Commission, headed by retired General Brent Scowcroft, published a scathing report on the Department of Defense's (DOD) decisions about the future of the heavy bomber force. The commission argued forcefully that the B-2 bomber is a revolutionary weapon system, and that the limited acquisition of only 21 B-2s was not in the best interests of national defense. In its criticism of DOD's decision to not purchase additional B-2s, the report argued that the revolutionary nature of the B-2 would have far-reaching impact in core interests such as manpower, budget, roles and missions.[16] The report argued that because "fighter generals" dominate the Air Force, they emphasized the procurement of fighter aircraft rather than bombers.

One reason for this is that the Air Force budget has been declining for more than a decade and that many fighter aircraft are on the verge of retirement. As a result, the B-2 bomber revolution might translate into reducing fighter procurement programs. It also might lead to an entirely new approach to warfare in which fighter aircraft might not be the dominant instrument of air power, which in turn means that the number of fighter aircraft, squadrons, wings, and ultimately fighter pilots could be substantially reduced.[17]

The commission's assessment of the B-2's performance potential was prescient given its performance during *Operation Allied Force* when these aircraft flew less than 1 percent of the total sorties but dropped 11 percent of the bomb load in the conflict -- all of those precision-guided bombs.[18] Interestingly, however, Air Force procurement battles tend to focus on the F-22 fighter rather than B-2 bombers.[19]

The 1998 congressionally chartered *Panel to Review Long Range Airpower* disagreed with the Scowcroft Commission's recommendation to reopen the B-2 bomber production line in favor of upgraded systems and weapons for the B-2, B-1B, and B-52 bombers.[20] However, the panel argued that these improvements would cover the nation's needs for only fifteen years. It also criticized the Air Force for failing to have an adequate plan beyond that timeframe for long-range bombers, and as a result, Congress directed the Air Force to prepare a long-term plan for the bomber force by March 1999.

In its new bomber study, the Air Force maintained that a regular program of technology upgrades would allow the current fleet of B-2, B-1B, and B-52 bombers to meet the nation's operational needs at an affordable cost through the year 2037.[21] However, on the subject of a replacement bomber, the Air Force was unmoved. It argued that since the year 2037 is when a new bomber would need to be fielded, the acquisition cycle should not be started until the year 2013.[22] The Secretary of the Air Force, F. Whitten Peters, announced that the Air Combat Command (ACC) was contracting for studies for a Future Strike Aircraft that will serve as the next generation long-range bomber.[23] In particular, the Air Force is interested in hypersonic (Mach 5) bomber concepts, although other subsonic proposals will be included in the studies.[24] Contractors will be permitted to propose other options for this Future Strike Aircraft, including unmanned vehicles.[25]

Impatient with this approach, Congress has directed the Air Force to do more.[26] Believing that a new bomber will be needed much sooner than the year 2037, the House Appropriations Committee and the House Armed Services Committee directed the Air Force to produce a Next Generation Bomber Study to evaluate options for a new bomber in the 2015 time frame.[27] In addition to technological, operational, and economic considerations, the lack of enthusiasm for a new long-range bomber from the service that once was the ardent champion of strategic bombing is interesting, especially since Congress has twice during the past two years demanded that the Air Force rework its long-range bomber plans.

*Expeditionary Aerospace Force.* The Air Force committed itself to the concept of the Expeditionary Aerospace Force (EAF), which represents a significant shift from the Cold War posture of forward basing

U.S. forces overseas.[28] With reductions in forward basing and overall cuts in U.S. military forces during the last decade, the Air Force has postured itself as an EAF so that it can deploy to any region on the globe and perform combat operations within forty-eight hours after being given the order to do so.[29] Since the EAF represents the "Air Force effort to organize, train and equip to create a mindset and cultural state that embraces the unique characteristics of aerospace power (range, speed, flexibility, precision) in all we say and do,"[30] the Air Force sees the need for "cultural changes" which it will foster through an "expeditionary warrior mindset."[31]

This reasoning is evident in the opening page of the new *Air Force Manual 10-100* entitled "An Introduction to Airmen."[32] In principle, every airman is indoctrinated to believe that the Air Force will respond to global crises by quickly moving its aircraft, support equipment, and personnel to a theater and then conduct air operations. The intention is to transform the forward-based mindset of the Cold War into an expeditionary approach so airmen's expectations match reality. But does this new mindset have a darker side?

The forty-year era of the Cold War ingrained its own mindset into the U.S. military from which it still struggles to disencumber itself ten years later. It is human nature that once any mindset is established, it has a tendency to become entrenched. While championing a new mindset is a good way to break with the old, the Air Force must be careful to keep its self-reflection fresh and not fall into the trap of zealously trading one inveterate mindset for another. An overly passionate commitment to and indoctrination in a particular way of thinking can inadvertently become a liability when, a generation from now, the world has changed again. With the implementation of the EAF concept, the Air Force is truly becoming organized, trained, and equipped for moving large numbers of aircraft, personnel, and equipment to a distant fight in the enemy's neighborhood. But this mental predilection can also mean any idea that does not fit the EAF mindset will likely have a difficult time taking root. For example, what about the idea of striking an enemy across the globe directly from the United States? .

The B-2 soundly demonstrated this capability during *Operation Allied Force*.[33] Even if B-2 bombers could operate without other support, the pace of operations from the United States with twenty-one aircraft will be quite limited. Since the Air Force is not shifting priorities to invest in more long-range bombers, the military must look to other non-aircraft options for possibilities for global strike. The United States already possesses intercontinental and sea-launched ballistic missiles that are capable of striking any point on the globe.[34]

While these technologies provide options for delivering conventional weapons at intercontinental ranges, reusable space launch vehicles could do the same by flying from and returning to the United States. These concepts for space-based global strike have important implications for the Air Force EAF mindset, and could enhance how aerospace power contributes to America's national defense strategy. With this as background, the following section examines the concept of space-based global strike.

## II. Space-Based Global Strike

According to the Department of Defense's *Joint Vision 2020*, precision engagement is critical to ensuring that the United States has the ability to deter conflict or fight and win wars.[35] The concept of space-based global strike, which rests on the ability to engage with an unprecedented degree of speed and precision, is defined as "the capability to conduct a precision strike with conventional weapons from U.S. soil to any point on the globe, including the recovery of any reusable launch platform onto U.S. soil."[36]

While virtually any aircraft that has the ability to refuel and deliver ordnance could be used for global strike, long-range bombers such as the B-1, B-2, and B-52, provide the only practical option at present. To cite a recent example, the B-2 bomber demonstrated with its thirty-hour missions from Whiteman AFB in Missouri during the Kosovo conflict, that it can conduct global strike missions.[37] As the Air Force explores concepts for conducting space-based global strikes, which would place targets anywhere on the globe at risk within ninety minutes of launch, such a world would contrast starkly with the expeditionary mindset that dominates.[38]

The Air University study *Air Force 2025* published in 1996 described the possibility of conducting global strike with conventionally armed ballistic missiles and space vehicles.[39] Later, the U.S. Space Command (USSPACECOM) in the 1998 *Long Range Plan: Implementing USSPACECOM Vision for 2020* outlined the value of global strike capability against fixed, mobile, and moving high-value targets. This study suggested that a limited capability could be available by 2005 with conventional ballistic missiles, that this capability could be increased significantly by 2012 with a military space operations vehicle, and that eventually a global strike capability could be mature by the year 2020.[40] To understand these issues, this section discusses the concept of space-based global strike with particular emphasis on conventional ballistic missiles (CBM) and space operations vehicle (SOV) that use reentry vehicles for delivering munitions to the target.

## Delivery Vehicle Concepts

*Conventional Ballistic Missile.* Intercontinental ballistic missiles (ICBM) and sea-launched ballistic missiles (SLBM) were developed early in the Cold War for delivering nuclear weapons across oceans and continents. These weapons became two legs of the strategic triad, with manned long-range bombers the third, and remain an important part of U.S. nuclear deterrent capability today.[41] The current generation of ICBMs and SLBMs are so accurate and reliable that rearming these vehicles with conventional weapons is technically trivial.[42] While there have been proposals for converting Air Force ICBMs into operational CBMs, this idea has not garnered significant support within the defense establishment.[43] And in the case of the U.S. Navy, there is no serious research and development work into land attack weapons that are designed to travel through space.[44] In fact, current and foreseeable Navy efforts for long-range strike focus on the Tomahawk cruise missile, advanced theater ballistic missiles, and new concepts for very long-range guns.[45]

In its work on developing a new ICBM to replace the aging Minuteman III force, the Air Force Space Command has considered an entirely new ICBM that could be used as a launch vehicle for nuclear and conventional weapons. Further, the USSPACECOM suggests that CBMs could provide an "intermediate capability to deliver conventional precision weapons transiting space."[46]

*Space Operations Vehicle.* In August 1994, President Clinton designated the National Aeronautics and Space Administration (NASA) as the lead agency for conducting the advanced technology development and demonstration for the next generation of reusable launch vehicles (RLV). NASA's experimental vehicle for the RLV program is known as the X-33 VentureStar, which is a half-scale version of the full-sized RLV designed to demonstrate and test flight characteristics of full-scale RLVs.[47] However, technical problems have caused the X-33 flight test program to slip from the original planned start in June 2000 to 2002.[48]

The Air Force is working with NASA to incorporate the military requirements for the RLV concept so that the SOV could perform military missions.[49] As envisioned, the unmanned SOV will be capable of flying sub-orbital "pop-up" trajectories that could place significant throwweights into orbit. For example, a SOV capable of orbiting 6,000 pounds could carry 40,000 pounds of weapons through space. Given the utility of the SOV as a reusable launch vehicle "workhorse" for all kinds of space launch missions, it is likely that the program will become operational with the military in some form. Accordingly to the USSPACECOM, the first SOVs could be potentially available for initial operational missions in 2012.[50]

*Common Aero Vehicle.* The common aero vehicle (CAV), a new concept in reentry vehicles, is planned for development and testing in the latter half of this decade.[51] The "common" in CAV means it can be used for any number of purposes and payloads and delivered by any kind of space launch vehicle. The CAV itself is essentially a shell weighing 1,300-2,400 pounds when fully loaded.

There are two distinct CAV design concepts. The first design is based on current reentry vehicle technology, which gives it downrange maneuverability but little or no cross-range maneuverability. This is lighter-weight design will be the first to be tested to demonstrate the basic technologies needed for a CAV. The second is a lifting body design that will able to maneuver up to 2,400 nautical miles cross-range and carry larger payloads.[52] Both will be able to deliver virtually any kind of payload to a variety of target types.[53] Some of these payloads and targets include a single unitary penetrator that uses the hypersonic speed of reentry from space as the kill mechanism rather than explosives for destroying deeply buried targets; precision area attack weapons such as the Low Cost Autonomous Attack System[54] (LOCAAS) for attacking ground mobile targets; the Small Smart Bomb[55] (SSB) for attacking fixed targets; specialized Agent Defeat weapons for neutralizing biological or chemical weapons; and the insertion of Unmanned Aerial Vehicles for reconnaissance and surveillance purposes.

The fundamental purpose of the CAV is to deliver "most of the same conventional munitions planned for use on the F-22, JSF [Joint Strike Fighter], B-1, and B-2."[56] However, there are many technical challenges with making the CAV a reality, including thermal protection during reentry, guidance and control, and release of the payload.[57] The Air Force Research Laboratory's Ballistic Missile Technology Division plans to conduct a series of missile technology demonstrations during the next several years that are designed to test these concepts.[58] Since the first CAV program is not considered high risk, CAVs should be available for deployment in the latter half of this decade, which would make this technology available for use on CBMs as early as 2005.[59]

**Operational Considerations**

The operational issues associated with conducting space-based global strike differ for each type of launch vehicle. Regardless of the command and control systems that are established for these weapons systems, space-based global strikes from the United States are likely to require the consent of the National Command Authority (NCA) before a combatant commander could employ these weapons.[60]

*Conventional Ballistic Missiles.* Fundamentally, a CBM has the same characteristics of a nuclear-armed ICBM. This fact is likely to cause great concern among countries that can detect the launch, and in theory lead it to increase the alert posture of its nuclear forces. The most difficult challenge with CBMs is to persuade nuclear states that this missile is not directed at them and, more importantly, is not armed with nuclear weapons. Accordingly, AFSPACE has conducted studies on how to reduce such concerns, including geographically separating CBM sites from nuclear missile sites, establishing agreements on CBM on-site inspection, and conducting pre-launch consultations and notification, among other options.[61]

One idea is to deploy CBMs at launch sites that are geographically removed from nuclear-armed ICBM sites. For example, AFSPACE proposed the establishment of two bases, one each on the East Coast and West Coast, at significant distances from nuclear missile sites, which would be open to inspection to confirm that the missiles carry conventional payloads. However, since arms control treaties are interpreted to mean that every CBM launch tube must be included in the total number of strategic launch silos that the United States can possess, the United States must be willing to sacrifice nuclear launch silos for a CBM capability.[62] At the same time, pre-launch consultations and notification could help reduce fears, but it is difficult to avoid the risks associated with the loss of tactical surprise, which could have critical consequences for the effectiveness of CBM strikes. Finally, there are technical options for making the CBM appear very different to surveillance and warning sensors.[63]

*Space Operations Vehicles*. The Air Force has considered the development of a space operations vehicle that could be launched within six hours of an order to do so, and perform the next mission within eight hours.[64] While SOVs could launch payloads into orbit, global strike missions will require a sub-orbital "pop-up" profile that allows it to be launched from and recover in the United States.[65] In principle, SOVs could deliver CAVs with a 2,400 nautical mile cross-range to virtually any geographic region of military interest.[66] In a notional study that compared the striking power of SOVs and B-2 bombers, six SOVs carrying 14,000 pounds of ordnance each could strike targets on the first day in comparison with ten B-2 bombers that could conduct their first strike on the fourth day.[67] With a response time of 6 hours and turn time of 12 hours, a fleet of SOVs could deliver more ordnance on target than ten B-2s until the B-2's second combat mission on the eighth day.[68]

**International and Domestic Political Implications**

*Weapons in Space.* The political impacts of space-based global strike fall into two categories. The first involves the political constraints that are derived from international treaties and agreements. At the same time, there are the international and domestic political issues, often related to mindsets, which reduce the chances that space-based global strike will develop sufficient political support.

The Nuclear Test Ban Treaty (1963), the Outer Space Treaty (1967), and the Treaty on the Limitation of Anti-Ballistic Missile (ABM) Systems (1972) all restrict military space activities. However, these instruments do not explicitly restrict CBM or SOV operations as long as these do not carry weapons of mass destruction; involve ABM testing, deployment, or operations; or interfere with space intelligence systems that are used during peacetime to verify treaty compliance.[69] Current National Space Policy guidelines state that "DOD shall maintain the capability to execute the mission areas of space support, force enhancement, space control, and force application." The clear intent is that the military should be prepared to conduct warfare in space if it is necessary to do so.[70]

However, the notion of deploying weapons in space of any type during peacetime is not consistent with current U.S. national policy. The USSPACECOM, which is keenly aware of this fact, is responsible for planning for the possible use of weapons in space "should our civilian leadership later decide that the application of force from space is in our national interest."[71] Simply transiting space with a sub-orbital weapon bound for a surface target should be the easiest type of space weapon to debate successfully. However, aiming weapons at satellites, placing weapons in orbit aimed at other things in space, or parking weapons in orbit to be de-orbited onto a surface target later are currently considered taboo. Furthermore, deploying a capability for space-based global strike would have to be managed with great diplomatic skill if the United States is to avoid an arms race in space. Thus, it is unlikely that any move toward weaponizing space would go unchallenged within the international community.

The domestic political issues with global strike through space concept may, in reality, be tougher to deal with than international issues. The first mindset obstacle is simply the idea of striking a distant enemy directly from the continental United States. This hesitancy seems odd, since the U.S. did this very ting with B-2s, fifteen hours from takeoff to target, against Serbia during *Operation Allied Force*. However, the idea of making a strike so direct and immediate (less than ninety minutes from launch) without the need for supporting forces in the region is, indeed, different than a long-range manned bombing mission.

This reluctance may be derived from the fear that an adversary will retaliate against the U.S. homeland in response to a CBM or SOV attack by the United States. Another response by an adversary would be well-timed acts of military sabotage in the United States, or the use weapons of mass destruction against U.S. friends or allies. These strategies could effectively hold the United States or its allies hostage as a way to deter the United States from launching space-based strikes. While U.S. adversaries might strike directly at the U.S. homeland as part of an asymmetric strategy, the underlying fear is that fielding a global strike weapon system might invite enemy strikes against the U.S. homeland.[72] This capability would give the United States an effective tool for launching an immediate and emphatic response against the perpetrator.

*Conventional Ballistic Missiles.* With the legacy of the Cold War in mind, the fact that ICBMs are directly and inseparably identified with nuclear weapons raises considerable problems for the proponents of using ballistic missiles with conventional payloads. The fundamental problem is that the launch of a CBM could easily be misinterpreted as a nuclear strike, and that various mitigating steps are unlikely to eliminate these fears among potential adversaries. Consider, for example, how the United States might react if Russia deployed a force of CBMs under the terms established by the AFSPACE study. It is extremely doubtful that the United States would willing acquiesce to a capability that would increase the risks of CBM launches being misinterpreted as a nuclear attack. Since this error could have disastrous consequences, states would not accept this risk, and thus it is likely that any attempt to deploy CBMs would be opposed by nuclear powers.

*Space Operations Vehicles.* The international and domestic political impacts of the SOV concept are much less severe than CBMs because this vehicle does not have "nuclear baggage." Another factor is that SOV will have been developed by a civilian agency. Since NASA has increased its commitment to the RLV program, the new vehicle could be operational for civilian use by 2010.[73] This non-military impetus virtually guarantees that the military SOV will be operational shortly thereafter.

Even if the military chooses a different approach than NASA's final RLV design, this new class of space launch vehicles was established for America's space program. The implication is that the Air Force can readily adopt this technology for its own uses, as was the case with the Space Shuttle. And unlike the CBM concept, the expectation that an SOV fleet will make frequent and routine "normal" military missions into space makes the transition to space-based global strike more manageable. Finally, as long as the triad of ICBMs, SLBMs, and manned bombers remain the mainstay of U.S. nuclear deterrence, there is no compelling reason to give SOVs a nuclear capability, which will preserve its status as a conventional weapon system.[74]

**U.S. Crisis Responses**

There are various ways in which a capability for space-based global strike could be used to deter U.S. adversaries in crises.

*Deter Weapons of Mass Destruction.* Air Force doctrine emphasizes the deterrent capability of combat airpower that has a global reach. Air and space forces can deter an adversary from taking actions that threaten U.S. interests, especially if the United States could project military power anywhere on the earth within hours. Deterrence would rest on the knowledge that air and space intelligence, surveillance, and reconnaissance systems are watching their activities; that long-range bomber and air mobility forces are ready to respond over intercontinental ranges with a large variety of capabilities; and that land-based fighter and attack aircraft could sweep the skies of enemy aircraft and prevent the movement of ground forces. All of these considerations are likely to cause the adversary's leadership to reconsider their objectives and plan of action.[75] While Air Force doctrine stresses the role of aircraft for global strikes, the ability to strike an aggressor through space directly from the United States within 90 minutes with conventional weapons would clearly add a new dimension to deterrence. The existence of this capability would force U.S. adversaries to re-evaluate their political and military strategies.

*Regional Nuclear Threat.* Since a nuclear-armed regional aggressor could threaten its neighbors and impede the ability of the United States to respond with military force, an arsenal of CBMs and SOVs that could strike targets within hours might persuade an adversary to carefully consider its chances of success. By relying on its superior technology and organization, using CBMs and SOVs for space-based global strike could deter regional adversaries. In the case of nuclear threats, CBMs and SOVs have the unique ability to strike from well beyond the range of an adversary's weapons -- and weapons falling from space would be virtually unstoppable. However, the ability to strike adversary targets precisely, effectively, and immediately with conventional precision munitions, and without the need for U.S. forces to be within range of the adversary's weapons, would constitute a significant military advantage.

*Chemical and Biological Weapons.* The capability for global strike from the United States provides important deterrent options against chemical and biological weapons. Since the U.S. policy of responding to the use of chemical or biological weapons with weapons of mass destruction may not be credible in all cases, the ability to strike a state from the United States with conventional precision weapons through space provides a credible option. This option is particularly important because the United States can avoid the use of nuclear weapons. At the same time, if it is necessary to conduct preemptive or preventive strikes against chemical or biological weapons or facilities, a capability for space-based global strike could hold targets at immediate risk regardless of their location or that of U.S. military forces.

**When Deterrence Fails**

The capability for using space-based global strike could be useful in the event that deterrence fails.

*Using Weapons of Mass Destruction Before U.S. Forces Deploy.* If an adversary uses chemical or biological weapons against bases and ports before U.S. forces deploy, it does so to impede the deployment and employment of U.S. forces. This strategy rests on the assumption that with its expeditionary forces, an adversary will have several days before U.S. forces are in a position to attack. While the use of chemical or biological weapons would further obstruct or delay the deployment of U.S. forces, the ability to use CBMs and SOVs would signal that U.S. counterattacks could begin within hours of the start of an invasion. While an adversary could increase the size of its invasion force because it anticipates that some forces will be lost in these strikes, the uncertainty about the effectiveness of U.S. weapons will inevitably complicate the adversary's defense planning.

The total forces available from space-based global strike would not be sufficient to halt a determined invader. However, the United States might attack other targets that are critical to the adversary in order to have an asymmetrically greater effect, which translates into attacking enemy centers of gravity.[76] As always, there will be instances when it will not be politically possible for the U.S. to strike certain critical targets no matter how much their destruction might coerce an enemy. As examples, Italy's surrender in 1943 was influenced by fears that further allied bombing might destroy Italian archival treasures.[77] And in the current political climate, the enemy's archival treasures would most probably be on the prohibited target list. Nonetheless, the threat of an early strike against an adversary's centers of gravity would likely have some deterrent value.

Perhaps the greatest value of space-based global strike would be a preemptive attack before the adversary commits aggression, such as invading the territory of a neighboring state. Even a token preemptive attack that was designed to demonstrate that an adversary was vulnerable could have important deterrent effects. Finally, the ability to halt the adversary's invading forces may be the most likely way for the United States to prevail.[78] In view of the munitions that could be available, space-based global strike could halt enemy forces and signal U.S. intent.[79]

*Using Weapons of Mass Destruction After U.S. Forces Deploy.* If an aggressor waits until U.S. and coalition forces start to arrive in the region before using chemical or biological weapons, it has yielded the initiative to the United States. Since it is likely that the United States would have warned the adversary about consequences of using weapons of mass destruction, a number of defensive systems would be deployed to the region to defend against missile attacks. If CBMs and SOVs had not been used, these weapons could provide a means for the United States to respond without using weapons of mass destruction.

In this case, space-based global strike further gives the theater commander greater operational flexibility, including targeting the enemy's chemical or biological weapons and facilities. Space-based global strike would also be highly responsive because the ability to precisely strike targets in less than 90 minutes provides an extremely fast response. Depending upon circumstances in the theater, space-based strikes may be the fastest way to attack time-critical targets, such as ballistic missiles. And having this global strike capability on call would give the theater commander tremendous flexibility and versatility in conducting global combat operations.

*Using Weapons of Mass Destruction to Prevent Strategic Defeat.* The use of chemical or biological weapons by an adversary is to prompt a U.S. response in kind, perhaps using its capability for space-based global strikes. Since these weapons are will be integrated into U.S. military campaign plans, space-based global strike increase the ability of the theater commander to fill targeting gaps that are caused by chemical-biological attacks on friendly forces, including attacks against enemy chemical-biological forces. The implication is that the ability of the United States to systematically eliminate the adversary's capability for using weapons of mass destruction is bound to influence whether the adversary believes it must "use or lose" these weapons. During the counter-offensive phase, when U.S. and coalition forces seek to strategically defeat the aggressor, global strike with CBMs and SOVs could be available to the theater commander as an "on call" capability or an active part of the campaign plan.

## III. Implications of Space-Based Global Strike

In designing its forces for the future, the Department of Defense will have many opportunities, such as that represented by the first Quadrennial Defense Review (QDR) in 1997, to establish a new strategic direction for the U.S. military. Some critics, however, believe that the QDR did not fulfill its potential because codifying the status quo among the military services did not create a dramatic shift in the U.S. military.[80] The Bush Administration is likely to confront, among other questions, the benefits and costs of increasing the U.S. military presence in space. In the context of that debate, the United States will need to consider the strategic implications of developing a capability for space-based global strike.[81] While this study focuses on the implications of space-based global strike for future U.S. military capabilities, its fundamental objective is to provoke a debate within the U.S. defense establishment about the value of this capability.

There are two time-related aspects that affect strategic choices about the value of space-based global strike. The first is how quickly this capability could be deployed, while the second is how responsive this capability could be in combat operations. While CBMs with first-generation CAVs could be deployed as early as the year 2005, SOVs would not be available until the year 2012 at the earliest. CBMs would provide an initial global strike capability until SOVs are available, but would provide a limited capability. If an adversary could successfully hold U.S. expeditionary forces at bay, CBMs would be capable of only token strikes.[82] However, if the invasion occurred after operational SOVs were available, a combined force of CBMs and SOVs could mount militarily decisive strikes against enemy forces.

A capability for space-based global strike provides an exceptionally quick means for delivering military force.[83] If launched from the United States directly against the target, space-based global strike could effectively and decisively attack enemy formations and targets. While this force might not be sufficient to stop a determined aggressor, the ability of the United States to use CBMs to target enemy weaknesses or vulnerabilities might persuade an aggressor that launching an invasion is unlikely to succeed.

While a detailed analysis of cost and operational effectiveness is beyond the scope of this study, the Air Force faces budgetary pressures to maintain its capability for air operations and space missions. The present Air Force space budget is about $7 billion per year out of a total annual Air Force budget of $75 billion. Of that $7 billion, about $4.1 billion is earmarked for new systems and procurement, while the balance is devoted to operating and maintaining existing systems.[84] Unfortunately, the space budget over the next 20 years will be inadequate to meet U.S. needs, will harm baseline programs, and weaken proposed initiatives and improvements.[85] While it is technically feasible for the Air Force to field CBMs and SOVs that are armed with CAVs carrying mini-UAV reconnaissance vehicles or munitions, the cost effectiveness of this capability is unclear in comparison with other military capabilities.

A critical question about deployment schemes for CBMs and SOVs concerns its political feasibility. Given the nuclear stigma associated with CBMs, it is unlikely that policymakers will be convinced to deploy this technology in the absence of a significant motivation. In addition to the problem that CBMs might legitimize the release of the nuclear genie, the decision to deploy a CBM capability could be contrary to U.S. nonproliferation policy. Rhetorically, the United States would be in an awkward position if it attempted to inhibit the proliferation of missiles and related technologies, while it used those same technologies to develop a conventional weapons system capable of striking any point on the globe.[86]

By contrast, SOVs may have greater political viability. In view of NASA's role in developing this technology, SOVs are likely to be developed. While nondestructive military applications, such as routine and emergency satellite launch, service, and recovery, are likely to dominate SOV operations, SOVs nonetheless present interesting options for policymakers. Since a fleet of SOVs that is designed for nondestructive missions would be significantly different from a force organized and equipped for global strike operations, the prudent option is for the Air Force to design SOVs for all missions. For example, military missions would require many more SOVs and a dedicated stockpile of precision munitions and CAVs. At the same time, command and control systems and procedures must be designed so that the weapon could be employed in a timely and effective manner.

One concept is to create a Civil Reserve Space Fleet, which is based on the existing Civil Reserve Air Fleet (CRAF).[87] The concept is to build a national space fleet of civilian (NASA) and military (Air Force) SOVs that the government could use for nondestructive missions in a crisis, while the Air Force could use SOVs for military operations. If NASA and the Air Force could ensure that these SOVs operate interchangeably, this arrangement would increase the U.S. capability to conduct military launches without the military owning and operating a large number of SOVs. By this logic, NASA and Air Force SOVs could maximize the U.S. ability to conduct peacetime operations, while preserving an important military capability.

In the end, the principal benefit of space-based global strike is the ability to strike virtually any point on the earth within a few hours and with complete surprise. The U.S. would possess a weapon that has a significant deterrent capability against many adversaries, regardless of whether U.S. military forces are deployed in a theater. With a sufficient number of SOVs, the United States could conduct sustained attacks to deter or halt aggression, while keeping U.S. forces beyond the reach of the enemy's weapons. This concept is likely to generate considerable controversy because it competes directly with existing military programs, forces, and service mindsets. The ultimate question is whether the United States should have the capability to strike an enemy virtually without depending on forward deployed or expeditionary forces. A related question is whether the ability to conduct space-based global strikes will reduce the likelihood of aggression and strategic surprise.

## IV. Conclusion

All of the military services are using advanced technologies to make warfare more lean, lethal, efficient, and effective, and to generate the greatest return on the nation's investment in the military. Despite the military drawdown in the 1990s, current U.S. forces still reflect the plans that emerged during the Cold War. However, we need to review the fundamental question of how the United States should manage strategic change in its military capabilities.

This study focused on the extent to which the United States could use space-based global strike for its defense. As the United States considers the implications of developing this capability, it is important to understand that the initiative will rest with the Air Force, which remains the dominant military service in space. And as the Air Force balances its capabilities in the air and space, the underlying reality is that the *raison d'etre* of the Air Force has always been air power and the airplane. The mission of the Air Force is "To defend the United States through control and exploitation of air and space."[88] It is inevitable that the decision to invest in space-based global strike has profound implications for the competition between traditional airplane-based and potential space-based approaches to using military force.

**Glossary**

| | |
|---|---|
| ABM | Anti-Ballistic Missile |
| ACC | Air Combat Command |
| ATD | Advanced Technology Demonstration |
| AFSPACE | Air Force Space Command |
| | |
| CAV | Common Aero Vehicle |
| CB | Chemical and Biological |
| CBM | Conventional Ballistic Missile |
| CRAF | Civil Reserve Air Fleet |
| | |
| DARPA | Defense Advanced Research Projects Agency |
| DOD | Department of Defense |
| | |
| EAF | Expeditionary Air Force |
| | |
| ICBM | Intercontinental Ballistic Missile |
| | |
| LOCAAS | Low Cost Autonomous Attack System |
| | |
| NASA | National Aeronautics and Space Administration |
| NCA | National Command Authority |

| | |
|---|---|
| QDR | Quadrennial Defense Review |
| | |
| RLV | Reusable Launch Vehicle |
| | |
| SEAD | Suppression of Enemy Air Defenses |
| SLBM | Sea Launched Ballistic Missile |
| SOV | Space Operations Vehicle |
| SSB | Small Smart Bomb |
| | |
| UCAV | Unmanned Combat Air Vehicle |
| USSPACECOM | U.S. Space Command |

## Notes

1. Carl H. Builder, *The Masks of War: American Military Styles in Strategy and Analysis* (Baltimore, MD: John Hopkins University Press, 1989), p. 6, who argued that, "Despite frameworks for defense planning, there is evidence that the qualities of U.S. military forces are determined by both cultural and institutional preferences for certain kinds of military forces as well as the threat."

2. Randy Steffen, *The Horse Soldier: 1776-1943, Volume IV* (Norman, Oklahoma: University of Oklahoma Press, 1979), pp. 130-132. "The use of machine guns in World War I proved a positive and lasting deterrent." But when the U.S. Army began converting cavalry regiments from horses to motor vehicles in 1931—14 years after the end of World War I—there was vehement objection by some members of the cavalry who believed "the horse would never be replaced by armored vehicles." Even after the cavalry office was closed in 1942, as late as November 1944 the War Department was discussing the possibility of using horse-cavalry units in the final stages of the war against Japan.

3. Edmund Beard, *Developing the ICBM: A Study in Bureaucratic Politics* (New York: Columbia University Press, 1976), p. 234.

4. The phrase "in one form or another" means to include both the classic definition of strategic bombardment as applied in World War II and the current theories of parallel warfare. For a description of parallel warfare theory, see the essay by John A. Warden III, "Air Theory for the Twenty-first Century," in *Battlefield of the Future*, ed. Barry R. Schneider and Lawrence E. Grinter (Maxwell AFB, Alabama: Air University Press, September 1998), pp. 103-124. See also, Carl H. Builder, *The Icarus Syndrome* (New Brunswick, NJ: Transaction Publishers, 1994), p. 32.

5. It is interesting to note that the V-1 "buzz bomb" was preceded by 25 years the Kettering "Bug" of WWI—an American pilotless plane with 300 pounds of explosives in 1917. See General H. H. Arnold, *Global Mission* (New York, NY: Hutchinson & Co., 1951), pp. 64-66. It is also worth noting the conflict between the German Army and the Luftwaffe over the V-1 and V-2. After the Battle of Britain when it appeared that the Army's V-2 might be relied upon exclusively, the Luftwaffe pushed the development and fielding of the pulse jet V-1—an airplane bomb rather than a rocket. This German interservice rivalry may have contributed to the delay in perfecting these weapons, which, in the judgment of General Eisenhower, could have made the invasion of France impossible. See Beard, pp. 220-221.

6. Walter Millis, *The War Reports* (Philidelphia, PA: J. B. Lippincott Company, 1947), pp. 462-463.

7. Michael S. Sherry, *The Rise of American Air Power: The Creation of Armageddon* (New Haven, CT: Yale University Press, 1987), p. 187. "I see a manless Air Force," he told von Karman: "I see no excuse for men in fighter planes to shoot down bombers. When you lose a bomber, it is a loss of seven thousand to forty thousand man-hours, but this crazy thing [V-2] they shoot over there takes only a thousand man-hours."

8. Beard, pp. 218-219; Builder, *The Icarus Syndrome*, pp. 32-33.

9. Beard, p. 223.

10 Trevor Gardner became the Assistant Secretary of the Air Force for Research and Development under Harold E. Talbot in the Eisenhower administration. Shortly after taking office, Gardner became convinced that the Air Force was underestimating the significance of ballistic missiles and sought a means to speed up development. He set up the Strategic Missile Evaluation Committee to do just that. In February 1954, the committee recommended that the U.S. must intensify its missile development program due to the expectation that the Soviet Union was likely doing the same for its thermonuclear weapons. Gardner seized upon the results and pressed the Air Force into establishing the Western Development Division, which was special organization that was designed to rush the ballistic missiles to successful completion. Within a year the Eisenhower administration assigned the program the highest national priority. See Bernard C. Nalty, *Winged Shield, Winged Sword: A History of the United States Air Force* (Washington, D.C.: Air Force History and Museums Program, United States Air Force, 1997), pp. 83-85.

11. Beard, pp. 237-238. "The ballistic rocket was at least implicitly a competitor to the manned bomber. The bomber was (and indeed still is) the central focus of identification within the Air Force. To conceive of a new weapon that might someday perform its primary task much more efficiently would require great restructuring of beliefs." However, note this interesting comment regarding the professional military education and the Icarus Syndrome: "But the most striking instance of the Icarus Syndrome is the Air Force's long delay in putting major resources into missiles. One may well ask whether the resistance of so may people to the acceptance of space weapons as a logical extension of the Air Force sphere of operations is yet another manifestation of the lack of rigor in the service's professional education system." From I.B. Holley, Jr., "Reflections on the Search for Airpower Theory," *The Paths of Heaven: The Evolution of Airpower Theory*, ed. by Col Phillip S. Meilinger, USAF (Maxwell AFB, Alabama: Air University Press, September 1997), p. 598.

12. DARPA/USAF Fact Sheet, "Unmanned Combat Air Vehicle Advanced Technology Demonstration," July 1999, p. 1.

13. The estimated savings in operation and support costs from the reduction in consumables, maintenance, and personnel with the UCAV are in the range of 50-80 percent of a current tactical fighter squadron. See DARPA/USAF Fact Sheet, p. 2.

14. G-forces are the acceleration forces when an aircraft turns rapidly, which are similar to the forces experienced in a centrifuge. Current high performance aircraft are designed for up to nine gs, or nine times the acceleration of Earth's gravity. The turning performance of aircraft are currently limited by the pilot's ability to maintain vision and consciousness under such g-forces. Without a pilot to worry about, vehicles could be engineered to withstand much higher g-forces than today's high performance aircraft.

15. The ATD is currently funded through Phase II, the Detail Design, Fabrication, and Flight Test which will run into FY02. If the UCAV continues with follow-on phases it could enter the inventory around 2010. See DARPA/USAF Fact Sheet, p. 4.

16. House Military Procurement Subcommittee of the Committee on National Security, *Final Report of the Independent Bomber Force Review Commission*, prepared by Brent Scowcroft, et. al., July 23, 1997, Committee Print, p. 13. "If additional B-2 bombers could make such a revolutionary contribution, why does the Pentagon oppose them? Basic principles of bureaucratic politics go far in explaining the Pentagon's position. We believe there is such strong opposition to the B-2 precisely because it is so revolutionary—because supporting the B-2 would imply far reaching changes in core organizational interests, such as manpower, budget, roles, missions, and autonomy."

17. *Ibid*., p. 14.

18. John A. Tirpak, "With Stealth in the Balkans," *Air Force Magazine* 82, No. 10, October 1999, pp. 23-24.

19. Robert S. Dudney, "F-22 Survives a Stealth Attack," *Air Force Magazine* 82, No. 11, November 1999, p. 11.

20. John T. Corell, "Long Range Blind Spot," *Air Force Magazine* 81, No. 6, June 1998, p. 3.

21. John A. Tirpak, "The Bomber Roadmap," *Air Force Magazine* 82, No. 6, June 1999, p. 31. The article points out that 2037 is "beyond the B-52's 80th birthday."

22. *Ibid*.

23. *Ibid*., p. 33.

24. Steve Douglass, "B-3 and Beyond," *Popular Science* 256, No. 2, February 2000, pp. 48-49.

25. Lt. Col. David W. McFaddin, ACC/XRMA, author interviewed, December 10, 1999.

26. Tirpak, "The Bomber Roadmap," pp. 34-35. Representative Duncan Hunter (R-Calif.) was impatient and dissatisfied with the roadmap, as was Donald B. Rice, former Secretary of the Air Force and a member of the panel, and General Michael B. Loh, the retired former commander of ACC.

27. McFaddin.

28. "Expeditionary Aerospace Force: Commanders 'Informing the Force' Detail Concept Paper," HQ USAF/XOPE, EAF Implementation Division, October 1, 1999, n.p.; on-line, Internet, March 21, 2000, available from http://www.af.mil/eaf/update_Oct99.pdf

29. It is worth noting that the 48-hour goal is attainable only if the operating airbase has significant infrastructure, host nation vehicles support, and prepositioned munitions. If the airbase is "bare base" (only a runway, fuel, and water) then the time from "execution order" to "bombs on target" would take 144 hours—almost a week. See Lionel A. Galway, et. al, "A Global Infrastructure to Support EAF," *Air Force Journal of Logisitics* 23, No. 2, Summer 1999, p. 4.

30. Department of the Air Force, *Air Force Handbook for the 106th Congress* (Washington, D.C.: Assistant Secretary of the Air Force, 1999), p. 26; on-line, Internet, March 30, 2000, available from http://www.doctrine.af.mil/library/misc/afhandbook.pdf.

31. "Expeditionary Aerospace Force: Commanders 'Informing the Force' Detail Concept Paper," n.p.

32. Air Force Manual (AFM) 10-100, *Airman's Manual*, August 1, 1999. "The Expeditionary Air Force (EAF) defines our structure, culture, and operations. We need to be a light, lean, and lethal fighting machine, prepared to make and keep the peace. Built in this concept is a mindset that we are ready to go anywhere, anytime to carry out our mission. This manual is how we'll do it."

33. David A. Fulghum, "Lesson Learned May be Flawed," *Aviation Week and Space Technology* 150, No. 24, June 14, 1999, p. 64. Stealth aircraft are not invulnerable, as the shoot down of the F-117 by Serbian air defenses proved. The same applies to all stealth aircraft; they are hardly visible to radar, but certainly not invisible, hence the need for electronic warfare support. See also Anthony H. Cordesman, "The Lessons and Non-Lessons of the Air And Missile Campaign in Kosovo," unpublished manuscript (Washington, D.C.: Center for Strategic and International Studies, revised September 29, 1999), p. 180: "The B-2s were normally supported by jamming aircraft and other support aircraft, and did not rely purely on their stealth capabilities."

34. Naturally, the exclusive association of ICBMs with nuclear weapons makes the idea of employing a conventional ICBM problematic, but not necessarily impossible.

35. *Joint Vision 2020* (Washington D.C.: Chairman of the Joint Chiefs of Staff, June 2000), 36 pp.

36. The current ICBM and SLBM weapons do not fit this definition of global strike because they carry only nuclear weapons.

37. John A. Tirpak, "With Stealth in the Balkans," *Air Force Magazine* 82, No. 10, October 1999, pp. 23-24.

38. *Long Range Plan: Implementing USSPACECOM Vision for 2020* (Peterson AFB, Colorado: U.S. Space Command, March 1998), p. 67.

39. Lt Col Jamie G. G. Varni, USAF, et. al., "Space Operations: Through the Looking Glass," *Air Force 2025*, Vol. 3, Chap. 14 (Maxwell AFB, Alabama: Air University, 1996), p. 14; *Air Force 2025: "America's Vigilant Edge,"* CD-ROM, Air University, 1996.

40. *Long Range Plan,* pp. 67-71.

41. Edward L. Warner III, "Nuclear Deterrence Force Still Essential," *Defense Issues* 13, No. 34, May 29, 1998, n.p.; on-line, Internet, November 15, 1999, available from http://www.defenselink.mil/pubs/di98/di1334.html.

42. The idea of converting nuclear ballistic missiles to conventional precision warheads is not exclusively an American idea. For example, France has considered options for CBMs including a modification of its HADES nuclear land-mobile missile. See Jean-Lois Prome, "Towards a French Non-nuclear Deterrent?" *Military Technology*, No. 6/93, June 1993, pp. 46-50.

43. For an overview of the conventional ICBM concept, see John R. London III, USAF, "The Ultimate Standoff Weapon," *Airpower Journal* 7, No. 2, Summer 1993, pp. 58-68; Robert Gibson, USAF, "Conventionally Armed ICBMs," *Airpower Journal* 9, No. 3, Fall 1997, pp. 119-123.

44. Commander Robert A. Aronson, Navy Headquarters, author interview, December 16, 1999.

45. For a comprehensive summary of the U.S. Navy's thinking on new developments in long range weapons for use in precision strikes from the sea, see Owen R. Cote, Jr., *Precision Strike from the Sea: New Missions for the Navy*, A Report of the M.I.T. Security Studies Program's Second Annual Levering Smith Conference (Cambridge, Mass.: MIT Security Studies Program, December 1997), n.p.; on-line, October 18, 1999, available at http://web.mit.edu/ssp/www/Publications/confseries/strike/strike_report.html. For a more recent summary, see Glenn W. Goodman, Jr., "Fires from the Sea," *Armed Forces Journal International*, April 2000, pp. 46-53.

46. Robert Wall, "USAF Weighs Multi-Role ICBM," *Aviation Week and Space Technology* 151, No. 16, October 18, 1999, 34; *Long Range Plan,* p. 67.

47. Bill Sweetman, "Space Giants Step Up Efforts to Win Low-Cost Launch Race," *Jane's International Defense Review* 33, March 2000, p. 30.

48. *Ibid*.

49. United States Air Force Scientific Advisory Board, *A Space Roadmap for the 21st Century Aerospace Force*, Vol. 1, SAB-TR-98-01 (Washington, D.C.: Scientific Advisory Board, November 1998), p. 27. While the SOV is called by other names, including the Military Space Plane (MSP) and Aerospace Operations Vehicle (AOV), for simplicity this paper uses SOV to refer to all three. However, the Space Maneuver Vehicle (SMV) is something different entirely, and should not be confused with the SOV. The SMV is a much smaller design that is intended to ride a first stage launch vehicle of

some type, similar to the SOV or an expendable launch vehicle, and provides second stage and on orbit maneuvering. It can remain in orbit for up to a year with a maximum orbital payload of around 1,200 pounds. The SMV is currently undergoing development and testing with the Air Force Research Lab at Kirtland AFB, New Mexico. See John Pike, "Military Spaceplane X-40 Space Maneuver Vehicle Integrated Tech Testbed," *Federation of American Scientists Space Policy Project Military Space Programs*, January 14, 1999, n.p.; on-line, Internet, November 11, 1999, available at http://www.fas.org/spp/military/program/launch/msp.htm.

50. For an excellent discussion on the argument of manned versus unmanned military space flight operations see Major David M. Tobin, USAF, "Man's Place in Space-Plane Flight Operations," *Airpower Journal*, 13, No. 3, Fall 1999, pp. 50-65; United States Air Force Scientific Advisory Board, *Report on United States Air Force Expeditionary Forces*, Vol. 2, Appendix G, SAB-TR-97-01 (Washington, D.C.: Scientific Advisory Board, February 1998), G-56; *Long Range Plan*, pp. 70-71.

51. For an excellent overview on the CAV, see George E. Richie, "The Common Aero Vehicle: Space Delivery System of the Future." Paper presented at the 1999 AIAA Space Technology Conference and Exposition. Albuquerque, New Mexico, September 1999.

52. Major Dana Struckman, AFSPACE/DR, Force Applications Division, author interview, November 15, 1999.

53. Richie.

54. LOCAAS consists of a laser radar (LADAR) sensor coupled with a multimode warhead and a maneuvering airframe that weighs around 100 pounds and looks like a mini-airplane. The LADAR sensor is capable of identifying specific types of ground targets and can distinguish among various types of tanks, vehicles, and mobile equipment to attack the programmed enemy vehicle. A powered version (P-LOCAAS) will have an extended range and search area allowing it to fly 100 km to a target area and then conduct a target search over a 90 square km area before running out of fuel. LOCAAS is currently undergoing testing at Eglin AFB as an Air Force Research Laboratory Advanced Technology Demonstration program. If the program is completed as planned, the Air Force will complete the test program in 2002. See John A. Tirpak, "The State of Precision Engagement," *Air Force Magazine* 83, No. 3, March 2000, p. 30; John Pike, "Low Cost Autonomous Attack System (LOCAAS) Miniature Munition Capability," *Federation of American Scientists Military Analysis Network*, November 29, 1999, n.p.; on-line, Internet, February 16, 2000, available at http://www.fas.org/man/dod-101/sys/smart/locaas.htm.

55. The SSB is a precision GPS-guided 250-pound bomb, six feet long and six inches in diameter, that is designed to be as effective against hardened targets as a standard 2,000-pound precision guided bomb. This allows a greater number of bombs to

be carried by a single platform with each SSB targeted independently. The preliminary results have been encouraging, and funding to develop and acquire SSBs has been programmed in the 5-year program beginning in fiscal year 2002. See John A. Tirpak, "The State of Precision Engagement," *Air Force Magazine* 83, No. 3, March 2000, p. 30; John Pike, "Small Smart Bomb Miniature Munition Capability Miniaturized Munitions Technology Demonstration (MMTD)," *Federation of American Scientists Military Analysis Network*, November 29, 1999, n.p.; on-line, Internet, April 13, 2000, available at http://www.fas.org/man/dod-101/sys/smart/mmc.htm.

56. United States Air Force Scientific Advisory Board, *Report on United States Air Force Expeditionary Forces*, G-60. An interesting variation on the CAV concept is called a "Jumbo" CAV, which is a larger version of the advanced design that can house a significantly greater payload. For example, the proposed CAV design is large enough to carry 7 LOCAAS weapons. A Jumbo CAV could carry 30 LOCAAS weapons, or more than four times as many as the regular CAV, and yet would probably cost less than twice as much. From Gregory K. Jenkins, Chief, Advanced Programs, Armament Product Group, Eglin AFB, Florida, author interview, November 9, 1999.

57. Richie.

58. Dr. Sandra Slivinsky, Chief, Ballistic Missile Technology Division, author interview, November 30, 1999.

59. United States Air Force Scientific Advisory Board, *Report on United States Air Force Expeditionary Forces*, G-60; *Long Range Plan*, p. 70.

60. An interesting thought, which raises potential problems for command and control, is that weapon which can hit any worldwide target in a matter of hours will be ready for launch more quickly than the NCA decision-making process. For the past 40 plus years only nuclear missiles had such quick responsiveness. But the Cold War did not help prepare national leaders for future decisions with conventional weapons like CBMs and SOVs because the greatest value of nuclear missiles is deterrence. Hence, the decision to launch a nuclear missile must be slow and deliberate, unlike the cases with conventional missiles or SOV platforms. And future speed-of-light weapons capable of hitting global targets, like the space-based laser, will further stress the decision making process.

61. Struckman.

62. *Ibid*.

63. *Ibid*.

64. *Ibid*.

65. Sweetman, p. 32.

66. *Ibid*, p. 33.

67. It is also worth noting that the B-2 bomber is designed to execute stealthy attacks under the cover of darkness, never in the light of day. Hence, B-2 combat operations will always be limited to hours of darkness over a target area, unlike space-based global strike that could be conducted at any time of the day or night.

68. Michael A. Rampino, "Concepts of Operations for a Reusable Launch Space Vehicle," *Beyond the Paths of Heaven: The Emergence of Space Power Thought*. Edited by Bruce M. DeBlois (Maxwell AFB, Alabama: Air University Press, September 1999), pp. 467-468.

69. *Ibid*., pp. 474-475.

70. The White House National Science and Technology Council, *Fact Sheet: National Space Policy*, September 19, 1996, n.p.; on-line, Internet, March 29, 2000, available from http://www.whitehouse.gov/WH/EOP/OSTP/NSTC/html/fs/fs-5.html.

71. *Long Range Plan*, p. 65.

72. Hence the call for "Defending the Homeland" in *A National Security Strategy for a New Century*, p. 16.

73. Sweetman, p. 30.

74. There is, however, no reason why the new CAV capability cannot be incorporated into ICBM and SLBM systems. The desire is to keep the ICBM and SLBM systems purely nuclear and confine the SOV to purely conventional strikes, thus avoiding the nuclear stigma.

75. Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, September 1997, p. 43.

76. Coercing an aggressor by threatening or taking away what he considers most dear is an asymmetric strategy that goes far beyond choosing physical targets. Every conceivable weakness a potential adversary has must be continually assessed by intelligence organizations, which must then be regularly evaluated in terms of what the adversary holds dearest and fears most, and what is the best means by which the U.S. can exploit that weakness. The result could be a computer network attack, a psychological operation, physical destruction—whatever best suits the targeted weakness. Unfortunately, the adversaries from whom we have the most to fear are usually those who have the least to lose.

77. Karl Mueller, "Strategies of Coercion: Denial, Punishment, and the Future of Airpower," *Security Studies* 7, No. 3, Spring 1998, p. 216.

78. Robert A. Pape, *Bombing to Win: Air Power and Coercion in War* (Ithaca, NY: Cornell University Press, 1996), p. 314.

79. Naturally, the decision to attack preemptively is fraught with potential political and military dilemmas. Such an attack could actually precipitate the invasion, or at least give the adversary an excuse for it. And the United States runs the risk of appearing to be

the aggressor if it strikes first. Preemptive attacks have their place, but must be carefully weighed against the potential political and military outcomes and effects.

80. George C. Wilson, *This War Really Matters: Inside the Fight for Defense Dollars* (Washington D.C.: CQ Press, 2000), pp. 40-43. For example, General Ronald Fogleman, the Air Force Chief of Staff at the time, said his reaction to the final QDR report was one of sadness; a sense of missed opportunity; a feeling of dread about the armed services' future suffering because no one had the fortitude to impose "true strategic change" on the U.S. military at the end of the twentieth century.

81. Bill Sweetman, "Securing Space for the Military," *Jane's International Defense Review*, March 1, 1999, n.p.; on-line, Internet, April 4, 2000, available from http://www.janes.com/defence/features/RAeS_aeards/securingspace.html.

82. Increasing the number of CBM launch tubes would increase the strike capability, but at the expense of nuclear launch tubes of the ICBM force.

83. *Long Range Plan: Implementing USSPACECOM Vision for 2020* (Peterson AFB, Colorado: U.S. Space Command, March 1998), p. 63. The USAF Scientific Advisory Board recommended that the Air Force should "not proceed with large-scale, on-orbit high-energy laser demonstrations such as the proposed Space Based Laser Readiness Demonstrator, but pursue aggressively the precursor efforts needed to enable global energy projection at the earliest feasible date." From United States Air Force Scientific Advisory Board, *A Space Roadmap for the 21st Century Aerospace Force*, p. xiii.

84. John T. Correll, "A Roadmap for Space," *Air Force Magazine* 82, No. 3, March 1999, p. 25.

85. *Ibid*. This budgetary problem was evident to the USAF Scientific Advisory Board. See the United States Air Force Scientific Advisory Board, *A Space Roadmap for the 21st Century Aerospace Force*, p. xvii. "The Air Force faces huge budget problems in space (and almost everywhere else) whether this study's recommendations are acted on or not. There is no way out of this dilemma that does not involve both changing fiscal priorities and divesting large pieces of today's Air Force mission and infrastructure."

86. Even if the CBM force were deployed with reconnaissance payloads only and not munitions, launching any long-range ballistic missile would send the wrong messages to nuclear and non-nuclear missile capable countries.

87. The CRAF permits a surge in military air transport capability by using civilian aircraft for personnel and cargo transport to augment military transport aircraft fleet.

88. Department of the Air Force, *Air Force Handbook for the 106th Congress*, (Washington, D.C.: Assistant Secretary of the Air Force, 1999), p. 4; on-line, Internet, March 30, 2000, available from http://www.doctrine.af.mil/library/misc/afhandbook.pdf.

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