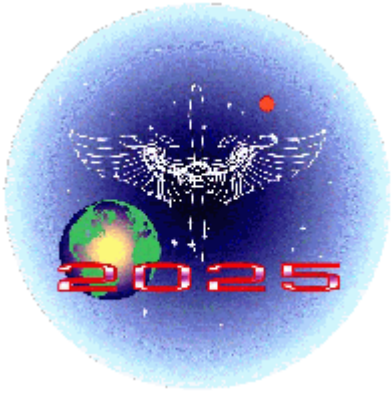
Space Operations: Through The Looking Glass
(Global Area Strike System)



A Research Paper

Presented To

Air Force ***2025***

by

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Disclaimer

2025 is a study designed to comply with a directive from the chief of staff of the Air Force to examine the concepts, capabilities, and technologies the United States will require to remain the dominant air and space force in the future. Presented on 17 June 1996, this report was produced in the Department of Defense school environment of academic freedom and in the interest of advancing concepts related to national defense. The views expressed in this report are those of the authors and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the United States government.

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Executive Summary

America's capability to operate in space is increasing with every passing day. Space operations are already recognized as a crucial part of all American military operations. Military space operations may be indirect, through such staples as navigation, communications, and surveillance/reconnaissance support to the war fighter, or direct, through development and fielding of a range of responsive directed energy and kinetic energy weapons. A modest fleet of flexible, mission-tailored transatmospheric vehicles (TAVs) has an important place in any thoughtful space operations architecture, providing the only conceivable way to insert human presence rapidly into the fast-breaking crises of ***2025***. Space represents the future-a future in which aerospace power will increasingly be projected through space systems.

This paper advocates a "system-of-systems" architecture for an American global space-strike capability in ***2025***. This architecture recognizes the importance of the global information network (surveillance and reconnaissance combined with the intelligence system), the military command and control system, the perennial space "utilities" (communications, navigation, and weather), and a robust readiness and sustainment system to enable the fielding of space-based or space-borne weapon systems. The weapon system itself is described as a smaller system-of-systems composed of the weapon, its platform, and a primarily off-board surveillance, acquisition, and tracking/battle damage assessment capability provided through the global information network.

After a review of the alternatives for a global space-strike system in ***2025***, the optimum solution appears to be combining a prompt response capability with a complementary flexible response capability. The prompt response capability is best provided by a system of Continental United States (CONUS)-based laser devices that bounce high power directed energy beams off a constellation of space-based mirrors. Inherently precise, megawatt-class, light-speed weapons can potentially act within seconds or minutes to resolve the rapidly developing crises of ***2025***. Flexible response is best provided with a small CONUS-based fleet of TAVs equipped with a variety of payloads, including kinetic-energy weapons, compact laser weapons, and special forces squads. Responding within a few hours of notification, a TAV can precisely deliver force and/or adaptable human judgment to crisis locations anywhere on earth.

The balance of influence in the information technologies has shifted from the Department of Defense to commercial organizations. This trend will continue and accelerate between now and ***2025***. The crucial importance of detailed, timely knowledge and rapid, ultrawideband communications to military space operations will demand the extensive use of commercial (possibly international) space systems and technologies. The world of ***2025*** will see a crowded "sky" filled with space systems shared by military and government organizations on the one hand and commercial concerns on the other.

Chapter 1
The World of *2025*

Once again a small but capably armed country is threatening to seize its smaller but resource-rich neighbor. The Global News Network reports that the border has been violated. The same old story? No, the plot twists as a sophisticated satellite surveillance and reconnaissance system tracks the belligerent nation's leader. As he steps to the podium to incite his troops to greater violence, a

blinding light from above vaporizes him and his podium leaving even his bodyguards untouched. His smarter brother, the second in command, countermands the invasion orders and in 12 hours the borders are restored. Stability, if not peace, reigns again.

This is not science fiction, but a mission well within the capabilities of Space Operations in ***2025***. By that year space operations will become the key to a wide range of military missions. Current US military space systems are an important force multiplier, but they do "not yet provide the seamless, reliable, rapidly delivered information needed by the modern war fighter."[1] To resolve this deficiency, space system designers must make a clean break with the expensive, large-scale, hand-built designs of 1996 and move to a new approach that emphasizes economy, efficiency, and operational utility in dynamic balance with rapidly evolving technological developments.

This paper highlights the importance of the full range of space operations while emphasizing the point that, in ***2025***, the United States must have a global space-strike capability. Why is this capability essential for military operations in ***2025***? All nations are becoming highly dependent on space assets for communications, weather forecasting, navigation and positioning, and surveillance and reconnaissance, and this dependency is growing at an exponential rate. To preserve the ability to use space and to deny space to aggressors, the US must have control of space. This need to control space will quickly overcome the political will to oppose weapons in space. Once this line is crossed-and its crossing is inevitable-we must be equipped to make use of space in a variety of novel ways.

The rapidly accelerating rate of technological change virtually assures that, by ***2025***, even the poorest nations will have access to electronic information and decision-making aids only dreamed of today. The average time required to complete an Observation, Orientation, Decision, and Action (OODA) loop will be much shorter in ***2025***[2]. In such a world, the US must be able to take rapid action (measured in minutes or perhaps even seconds) to resolve conflict situations before they can grow out of control. The essential capabilities of timeliness or responsiveness can certainly be provided by a properly designed space-strike system and perhaps only by such a space-strike system.

Because the world of ***2025*** will provide smaller countries and organizations with far greater abilities to disrupt our nation and its allies, we will need measures flexible enough to produce effects across the full range of the "spectrum of force," ranging from the nonlethal (deceit, delay) to the lethal (damage, destruction). The requirement to produce the right effect on the right target at the right time is as desirable in a space-strike system as it is in today's more familiar combat systems.

The Space Operations Mission

The heart of the space operations mission is the *global presence* concept as encapsulated in the following summary from the Department of the Air Force Global Presence 1995 document:

"As we peer into the future, we should view *Global Presence* as one route the Services can take to achieve our country's ever evolving national security objectives. We in the military possess the means, physical and virtual, to provide America continuous awareness of world events and a force capable of projecting military power worldwide, in minutes or hours, with little or no warning."[3]

While the notion of global presence is a concept of 1996, its principle will remain a constant for decades to come. The name may change, but the mission will remain crucial as long as the United States wished to remain a world power. Much of America's global presence already depends on the world's highest technology systems operating freely from "the high ground of space." The only essential element missing in 1996 is a force projection capability operating through the space environment. (see appendix A).

In the fast-paced world of ***2025***, the volume of space near earth (at and below geosynchronous orbit)

will be filled with the space assets of many, if not all, nations. The commercial, civil, and military possibilities inherent in the high ground of space will be fully exploited. These future space systems will be distributed and interconnected in ways we can only dimly imagine today. It may even be impossible to point at any single piece of space hardware and say "this belongs to the United States." Instead, a nation and nongovernmental organizations (NGOs) may use various parts of various space assets at different points in time.

The Topic of Discussion

The military's space support and space-control missions in ***2025*** are described in other AF ***2025*** white papers. The force enhancement mission is addressed from several points of view in other white papers involving surveillance and reconnaissance and information operations.[4] This paper will concentrate primarily on the space force application mission and those elements of force enhancement which relate directly to the military application of force through the medium of space.

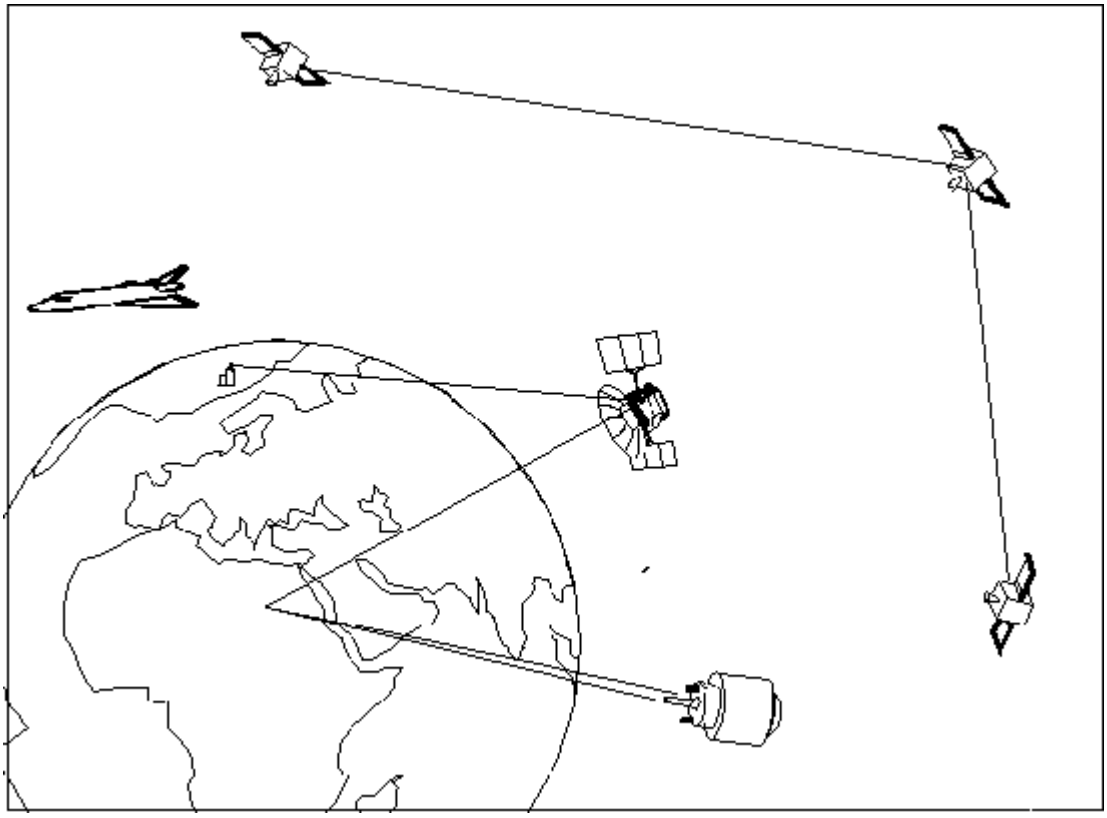

Figure 1-1. The View from Space

Issues Involving Space Operations in *2025*

Several trends are already evident in the world of 1996 that will fundamentally influence all future operations in space. Although the precise impact of these trends cannot be predicted with confidence, certain broad conclusions appear inescapable.

Manned Versus Unmanned Systems

For years, the "proper place" for manned and unmanned space vehicles has remained unchanged. Deep space, long-duration planetary exploration has been performed by unmanned robotic space probes. Space-based communication, remote sensing, weather and navigation missions are also performed with sophisticated unmanned platforms well suited to operation in the hostile environment of space. Manned missions are limited to complex scientific and (frankly) public relations endeavors.

Considering the likely advances in telepresence, virtual reality, and wideband communications linked with secure, reliable, remote piloting techniques, there will probably be no requirement for a sustained human presence in space through at least the ***2025*** time frame, at least in regard to military missions. With the single exception of limited space sorties delivered by transatmospheric vehicles (TAV), all of the space systems discussed in this paper are hosted by unmanned platforms.

Large Versus Small Satellites

The conventional approach to space systems involves large satellites (weight in excess of 500 kilograms) containing as many multimission payloads as will fit on the booster. The emphasis on high-volume, high-weight satellites has contributed to the enormous cost of developing and fielding space systems. A recent, and very attractive, alternative involves the use of small (weight below 500 kilograms) or even micro (weight below 50 kilograms) satellites launched by cost-effective boosters such as the Orbital Sciences Corporation's Pegasus. Commercial remote-sensing satellites are already being developed with a panchromatic spatial resolution as good as one meter and multispectral resolutions below 20 meters.[5] Other uses for small and microsatellites will develop naturally as an outgrowth of continuing advances in the areas of materials, small sensors, miniaturized electronic and mechanical systems, inexpensive space launch, and packaging.[6] Soon, satellites will no longer need to be large, heavy structures overloaded with redundant systems. Small and microsatellites will be able to perform all the functions carried out by today's large, "one of a kind" satellites.

Ground Versus "Anywhere" Processing and Delayed Versus Near Real-Time Information

The volume of scientific and intelligence data, including high-resolution imagery, is growing at an alarming rate. To handle this increased traffic, it will be necessary to install ever more capable onboard processing power on satellites equipped with advanced visible, infrared, and radar sensors. By ***2025***, it should be possible to process even the most complex images onboard in real time.[7] Full image data sets will no longer need to be transmitted to central ground stations for slow postprocessing. These real-time images can then be "fused" with other forms of militarily significant intelligence information, in near real time, and at any location desired-all made possible by microprocessors perhaps a million times more capable than anything we possess today. Combined with high-volume, high-bandwidth communications (perhaps laser communications), the military commander's dream of understandable, near-real-time information on demand will finally be possible. The "fog of war" will not be fully lifted in this way, but it will be significantly thinned.

Military Versus Cooperative/Commercial Endeavors.

The end of the cold war and the subsequent decline in military budgets has forced the US Air Force to reconsider its traditional posture on space operations. Every day, more foreign governments and commercial concerns are gaining access to space, turning near-earth orbit into a very busy place. Technologies once driven solely by US government dollars are increasingly dominated by private funding. Clearly, significant opportunities exist for the US Air Force to share the assets (and technological developments) of commercial concerns and even foreign governments to accomplish important missions such as communications and remote sensing.[8] In particular, the large civilian investments in electronics, sensors, advanced communications, and information systems will soon exceed the military's research budget in these areas. Long before ***2025***, the US military must learn to adapt the technological developments of others to meet national security needs. This will not exempt us from our need for space superiority, and actually will drive our need for greater technological superiority in a variety of areas.

In the year ***2025***, military space operations will be augmented by vastly improved passive and active sensors, producing the nearly continuous global surveillance and reconnaissance capability

(sometimes called "global awareness") required to project power on a global scale flexibly and effectively. These improvements will include the capability to detect and track fixed and mobile targets in all weather conditions with sensors accurate enough to provide useful battle damage assessment.[9] This will be possible not through military-specific technological advancements but through synergistic civil, military, and international developments. All of these abilities will again be essential for a nation that desires space superiority and the capability to project force from space.

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