AMERICAN FOREIGN POLICY COUNCIL

DEFENSE TECHNOLOGY PROGRAM BRIEF

Hypersonic Weapons and the Case for a Space Tracking Layer

By: Christopher M. Stone

BRIEFING HIGHLIGHTS

The advent of hypersonic weapons capable of carrying conventional or nuclear payloads to targets within the U.S. and against deployed U.S. forces abroad poses a serious threat. Given the curvature of the Earth, as well as the speed, altitude, and maneuverability of hypersonic weapons, the only way to provide national political and military leaders with this reliable coverage is to place sensors in orbit around the Earth.

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With a space tracking layer in LEO, the U.S. will have the global coverage necessary to find, fix, track and target ballistic and hypersonic missile systems. In order for deterrence to remain credible, our forces must remain capable of surviving attacks and striking back as needed should deterrence fail. If the adversary has free reign to strike the U.S. as a result of sensor gaps, the credibility of American deterrence will be seriously degraded.

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ASAT systems, combined with hypersonic missiles, are key to China's plan for negating the U.S. ability to intervene in support of regional allies (such as Japan and perhaps even Taiwan). Hypersonics and ASATs converge within what they call a "multi-layered attack architecture," the goal of which is to gain and maintain space superiority and comparative advantage over U.S. forces.

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As the hundreds of satellites in the Tracking Layer are deployed, making decoy satellites that look and act like the others would complicate an adversary's targeting calculus and make it more difficult for them to target the true system satellites. Leveraging already operational commercial systems—such as those of SpaceX—to host sensor payloads would add another layer of survivability for the Space Tracking Layer, assuring that global coverage for sensing hypersonic or ballistic missile strikes remains constant during periods of tension or war.

In 2019, the People's Republic of China and the Russian Federation both formally announced that they were developing and deploying conventional as well as nuclear-tipped hypersonic missiles. The development of these new weapons systems marks a new phase in the long-running military competition between the United States and both countries, and has been the impetus for the Department of Defense (DoD) to re-assess the credibility and effectiveness of its deterrence and warfighting postures for the first time since the Cold War. Yet while the "threat" of these weapons is acknowledged, what remains lacking, even following the release of the latest *National Defense Strategy* (NDS) and *Defense Space Strategy* (DSS), is a strategy capable of re-focusing our national defense posture to make it capable of addressing and overcoming the new challenges these capabilities pose to U.S. nuclear and space deterrence.

Such a strategy should begin by denying the potential adversary—China, as per the NDS—the ability to carry out a surprise attack because of gaps in existing ground and space-based sensors capable of tracking hypersonic weapons.[1] Given the curvature of the Earth, as well as the speed, altitude, and maneuverability of hypersonics, the only way to provide national political and military leaders with this kind of coverage is to place sensors in orbit around the Earth.[2] Without such a space tracking layer, the United States will remain vulnerable to a surprise attack by adversary hypersonic weapons, which will have the effect of holding our nuclear deterrent forces at risk, degrading the credibility of our own deterrent, and gravely harming the ability of U.S. forces to defend the homeland and mount retaliatory attacks if necessary.[3]

The Evolution of Space Tracking

The advent of hypersonic weapons capable of carrying conventional or nuclear payloads to targets within the American homeland and against deployed U.S. forces abroad underscores a stark reality: the United States is vulnerable to hypersonic attack.[4] This state of affairs may be surprising, at first blush. After all, the United States already possesses early warning radars and satellites capable of tracking and sending data to missile defense interceptors. These capabilities, however, are woefully deficient in addressing the hypersonic threat.

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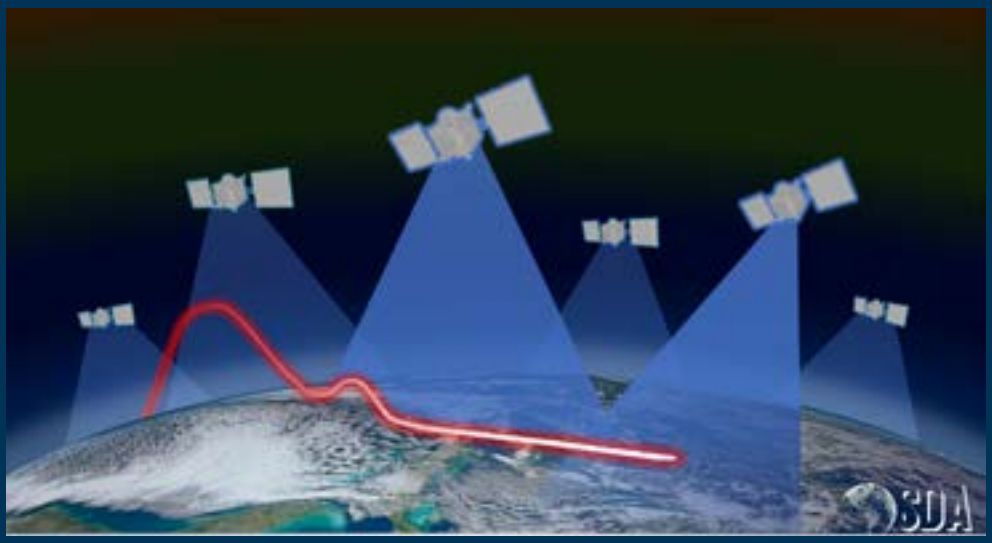
FIGURE 1: SPACE TRACKING LAYER



Source: Space Development Agency, VIRIN: 201005-D-ZZ999-002.

Since the early days of the Cold War, an enduring lesson has been that, in the age of nuclear weapons, a surprise attack of any sort must be prevented at all costs. In the event of conflict, there would not be time to mobilize the industrial base of the nation for eventual hostilities. The nation would have to be ready to go to war with the personnel and equipment it needed at the outset. Better yet, however, would be to be capable of deterring the attack from occurring in the first place. To achieve this state of readiness, however, the opportunity to conduct a surprise attack must be denied to the enemy through the creation of early warning networks and intelligence.

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The first such early warning was geared toward the threats of manned Soviet bombers coming over the polar region. The Distant Early Warning (DEW) line was one of the North American radar arrays pointed toward the potential flight paths that could be taken by Soviet bombers. Due to the relatively slow speeds of bombers at the time, this early warning capability provided U.S. and allied leaders with several hours during which to discuss the situation, and to mobilize nuclear or conventional deterrent forces for survivability dispersal and retaliatory operations. By the late 1950s, however, the advent of the Intercontinental Ballistic Missile (ICBM) shrank this timeline of several hours down to half-an-hour or less. Submarine Launched Ballistic Missiles (SLBMs) shrank warning times still further, to less than fifteen minutes. Something had to be done to deal with this time compression; senior leaders needed the time to think and prepare to react to aggression. This realization led to early thinking about a space-based sensor layer that would provide additional warning capacity, in conjunction with the ground-based radar system then being developed to detect missiles.

As the Cold War came to an end, and with it the threat of overwhelming attacks by missiles from the Soviet Union, this system of dual phenomenology—in which both ground-based radars and space-based sensors were required to prevent an inadvertent nuclear war—appeared sufficient to address the danger of rogue nation missile strikes. No additional dangers seemed to be on the horizon, so the objective was to simply to maintain the existing level of readiness. Today, however, the situation is very different. After a twenty-year hiatus, strategists in

the United States now face a threat that highlights the shortcomings of the current system—which, while great for tracking ballistic missiles of various types, is wholly inadequate to address high-speed maneuverable threats. Simply put, hypersonics have brought time compression and surprise attack back into the strategic vocabulary.[5] This is where a space tracking layer becomes critical.

The STL Proof of Concept

Current Space Development Agency (SDA) concepts of operations have the Space Tracking Layer, the second layer of the proposed National Space Defense Architecture, consisting of two main components: a proliferated Low Earth Orbit (LEO) constellation of Wide Field of View (WFOV) satellites, and a proliferated LEO constellation of Medium Field of View (MFOV) satellites.[6] Both constellations are made up of hundreds of satellites that are designed to "provide global indications, detection, and tracking of advanced missile threats, including hypersonic missile systems."[7]

While the WFOV constellation is designed to operate independently of legacy or third-party systems, the MFOV constellation is designed to provide additional tracking coverage with collaboration with other systems, both ground-based and space-based.[8] The objective of this dual approach is to "provide complementary mission data to Command and Control (C2) and operational interfaces."[9] This is necessary for adding time back into the C2 decision calculus of U.S. and allied leadership, as well as for negating the ability of hypersonic missiles to achieve strategic surprise through the exploitation of gaps in coverage associated with legacy radar and infrared tracking sensors.

With such a space tracking layer in LEO, the United States will have the global coverage necessary to find, fix, track and target ballistic and hypersonic missile systems.[10] Without it, the United States will remain vulnerable to conventional and nuclear attacks at hypersonic speeds.[11] Given the ongoing consolidation and reduction in the size of U.S. nuclear and conventional forces, the issue of survivability becomes paramount. In order for deterrence to remain credible, our forces must remain capable of surviving attacks and striking back as needed should deterrence fail. If the adversary has free reign to strike the U.S. as a result of sensor gaps, the credibility of American deterrence will be seriously degraded. A space tracking layer, along with the rapid deployment of hypersonic missiles of America's own, represents a concrete step toward returning first-strike stability to the international environment.

*A **space tracking layer** is **vital to** the **survival** of the **United States** and the defense of its strategic interests in the 21st Century era of great power competition. However, while this system is vital, it is **not without risks** and vulnerabilities of its own—including **to attack by kinetic energy Anti-Satellite (ASAT) forces**.*

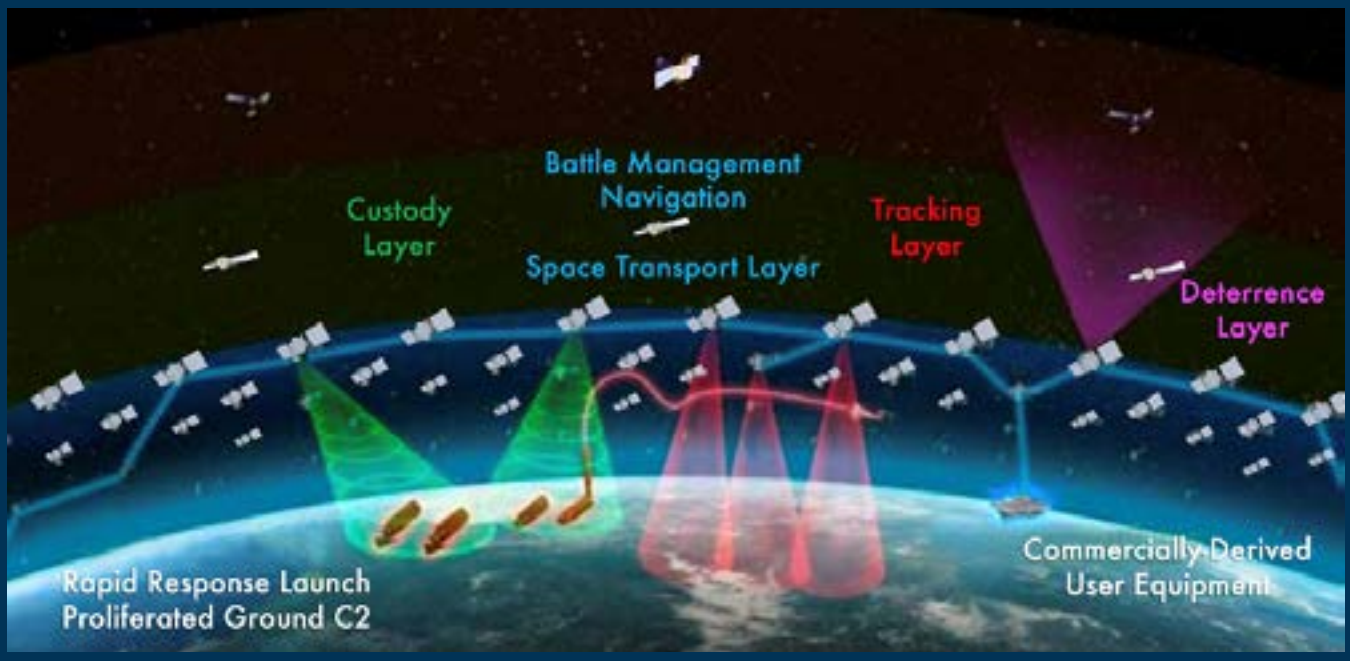
Lingering Issues

A space tracking layer is vital to the survival of the United States and the defense of its strategic interests in the 21st Century era of great power competition. However, while this system is vital, it is not without risks and vulnerabilities of its own—including to attack by kinetic energy Anti-Satellite (ASAT) forces.

Most DoD documents related to proliferated LEO concepts of operations appear to place trust in the "resilience" inherent in the space layer's design. Resilience is defined by the Office of Secretary of Defense's Office of Space Policy as the "ability of an architecture to support the functions necessary for mission success with higher probability, [or] shorter periods of reduced capability."[12] While most space layer advocates argue that resiliency is created by the hundreds of satellite vehicles in the constellation (since an adversary could never conceivably shoot down all of them at once), quantifying and measuring resilience across this or alternative future systems remains challenging.[13]

In other words, it is hard to know how resilient a specific constellation, even a proliferated LEO system, might be due to the constant change in the development of countermeasures.[14] As of now, no such study regarding the resilience of the National Space Defense Architecture exists—a fact senior leaders acknowledge when pressed.[15] In the absence of such a survey, U.S. officials have come to rely on the notion that adversaries view an attack on critical space infrastructure as "politically difficult." Such an assumption, however, is predicated on the belief that America's adversaries have similar strategic and international worldviews to our own, and would view attacking proliferated constellations as

FIGURE 2: SPACE TRANSPORT LAYER RESILIENCE



Source: Space Development Agency, VIRIN: 201005-D-ZZ999-001.

untenable or problematic. Yet a survey of attitudes in Beijing makes clear that this is not, in fact, the case.

When it comes to China, the strategic reality facing the United States is not one of "mutual deterrence" or "mutual vulnerability," but rather one in which customary international norms such as freedom of overflight are now being contested or ignored. For example, the trend in People's Liberation Army (PLA) writings is to assert that territorial claims in space are not inconsistent with international law because there is no legally accepted definition of where "outer space" begins. As PLA Major General Cai Fengzhen makes clear:

> The area above ground, airspace, and outer space are inseparable and integrated. They are the strategic commanding height of modern…warfare…The airspace over territorial waters and territorial lands are protected, but there is no clear standards in international law as to the altitude to which territorial airspace ends [and outer space begins][16]

Moreover, while many Western governments view resilience as a mode of deterrence and dissuasion, the Chinese believe in the idea of pro-active self-defense and "attacking to deter." In the PLA's writings on space warfare and deterrence, words and empty threats grounded in deception are not the methodology of choice. Instead, developing "real capabilities" [i.e. weapons] for space attack are considered by Chinese planners to be the "integral part of battle planning... in any future conflict…" including during "periods of tension."[17]

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In this paradigm, ASAT systems, combined with hypersonic missiles, are key to the Chinese side's plan for negating the U.S. ability to intervene in support of regional allies (such as Japan and perhaps even Taiwan). Hypersonics and ASATs converge within what they call a "multi-layered attack architecture," the goal of which is to gain and maintain space superiority and comparative advantage over U.S. forces. As one PLA author notes:

> Commanders should actively take the initiative to strike at the enemy's vital targets because only through active offensive operations and counter attacks can one seize and maintain the initiative. Specifically, vital targets include information, command and support systems. Hitting these vital targets through concentrated strike is especially recommended in cases where the PLA faces a powerful enemy equipped with high technology weapons and equipment…[18]

What type of "information, command and support systems" are these Chinese strategists talking about? The PLA author explains:

> …the first targets of a campaign… are the detection, command and telecommunications, information systems, who's degradation or destruction will negate or remove the enemy's ability to control information and create [favorable] conditions for later combat.[19]

Thus, the resiliency of proliferated LEO constellations is not a deterrent or a protective measure, *per se*, against China's buildup of space weapons and hypersonics. Rather, it is viewed as a vulnerability that can easily be exploited, as well as a low threshold target with a favorable cost-benefit analysis. Chinese space deterrence and warfighting options focus on "rapid and destructive" engagements against "low threshold" types of U.S. space systems that are "easy to attack and difficult to defend."[20] The objective for Chinese forces is to "exploit the heavy [American] reliance on space systems for peacetime and wartime operations."[21]

Given that the Space Tracking Layer is within range of Chinese deployed ASATs, and in light of the fact that the specific purpose of those weapons is to hit vital space-based detection assets, more must be done in order to remove the dual first-strike instability that Chinese hypersonic and ASAT forces create.

Strategic Challenges Facing the U.S. in Space

American space infrastructure, including the proposed Space Tracking Layer, is not only an inherent strategic asset for the United States. Its supporting ground and orbital segments represent vital pieces of the nation's critical defense infrastructure. As such, it is a key center of gravity for American instruments of national power. This fact is not lost on potential adversaries such as the People's Republic of China, who have developed kinetic energy ASATs and other forms of space weaponry to hold such "soft ribs" at risk.[22] This, in turn, points to the need for U.S. policymakers to ensure that critical American space infrastructure is actively protected and available to support the safety and prosperity of the U.S. population, homeland defense, and, when needed, force projection worldwide.

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But such an important defense component as strategic early warning against ballistic and hypersonic missiles must rely on stronger measures than mere "resilience" for "protection." As is the case for the nuclear triad, survivability must be the main focus of design, development, and deployed operations of the Space Tracking Layer. How, then, can the survivability of this critical emerging piece of America's space puzzle be improved?

First, survivability can be assured through the use of decoy satellites deployed as part of the STL constellation. In nuclear deterrent force design, decoys have played a large role in ensuring the survivability of weapons systems against adversary first strikes. As the hundreds of satellites in the Tracking Layer are deployed, making decoy satellites that look and act like the others would complicate an adversary's targeting calculus and make it more difficult for them to target the true system satellites. However, given China's low threshold view of space attacks, as well as the comparatively low cost of kinetic energy ASATs, this step alone may not diminish an adversary's determination to target every satellite, or even most of them.

As a result, DoD could also consider using commercial proliferated LEO constellations of similar orbital mission parameters to host payloads as well. Leveraging already operational commercial systems—such as those of SpaceX—to host sensor payloads would add anoth-

er layer of survivability for the Space Tracking Layer, assuring that global coverage for sensing hypersonic or ballistic missile strikes remains constant during periods of tension or war. Moreover, from the strategic standpoint, adding such survivability into the design and basing of the Space Tracking Layer will contribute to increased doubt in the minds of Chinese leaders that their "multi-layered attack architecture" would in fact be successful.[23]

Space sensing is a multi-layered and complex issue. This article is merely a first step in examining how to improve our strategic vision and posture in space, and much needs to be done to properly explore the vulnerability, survivability and affordability of America's space assets. Time, however, is of the essence. Given the evolving strategic situation both on Earth and in space, preserving U.S. primacy and security will require unconventional thinking and prompt action.

ENDNOTES

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