NATIONAL INSTITUTE FOR PUBLIC POLICY

INFORMATION SERIES

HON. DAVID J. TRACHTENBERG, *Editor*
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Issue No. 504 October 12, 2021

Missile Defense and the Space Arena

Dr. Steven Lambakis
Dr. Steven Lambakis is the Director of Space Studies at the National Institute for Public Policy and Editor-in-Chief of Comparative Strategy.

Interest by political and military leaders in the United States in adopting the view that space, like the land, sea, and air, is a warfighting domain is growing.[1] This shift in opinion in the nation's governing and defense-planning circles about the importance of space to national security has led to the reorganization of the Joint Force (establishment of a Space Force) and command structure (reestablishment of U.S. Space Command) to protect U.S. space assets and mature U.S. spacepower. The Missile Defense Agency and its predecessor organizations have understood the importance of leveraging space to accomplish the ballistic missile defense mission since President Ronald Reagan introduced his Strategic Defense Initiative in 1983. Even before then, Army, Navy, and Air Force missile defenders looked to space for a tactical advantage.[2] Is space important to missile defense? If one is observant of history and understands what steps must be taken to destroy in-flight offensive missiles, potentially armed with weapons of mass destruction, then the answer is, "yes, of course."

Where is the Urgency?

Over the past three decades, the ballistic missile threat, especially from North Korea and Iran, has continued to grow with the development and deployment of more missile systems, systems

with global reach, increased speed and maneuverability, greater accuracy, and improved countermeasures. Hypersonic and cruise missiles, which fly very differently from ballistic missiles, are also a growing concern. Russia and China operate advanced ballistic and cruise missile forces, and they are developing and deploying advanced air- and surface-launched long-range cruise and hypersonic missile capabilities. Importantly, hypersonic missiles are being developed to bypass perceived U.S. missile defense capabilities. Regional hypersonic missiles are capable of holding deployed U.S. forces, allies, and partners at risk, so that hypersonic glide vehicles delivered by ballistic missile boosters will pose new challenges to U.S. regional missile defenses.[3]

While there is always room for some disagreement, it may be argued that missile defense policy since the Missile Defense Act of 1991 has been fairly consistent. The protection of the homeland from limited rogue state missile attack, and defense of U.S. deployed forces, allies and international partners from theater or regional missile attack usually tops the list of objectives. Other objectives have included supporting and contributing to U.S. deterrence objectives, limiting the number of adversary missile warheads that strike their targets and enabling operational success in military conflict. It is generally recognized that missile defenses also provide leaders options and additional time to respond to attacks or stabilize a crisis situation, and they can assure U.S. allies and reinforce alliance unity. U.S. policy also has emphasized that effective missile defenses can dissuade other countries from pursuing a ballistic missile arsenal in the first place or even shape the adversary's decision calculus by diminishing the perceived value of their missile forces in a battle.[4]

So, given the important role missile defenses play in U.S. national security and the generally acknowledged importance of space to the performance and effectiveness of the Missile Defense System (MDS), why has the United States not truly leaned into this obvious reality of missile defense from a policy and budgetary perspective? Without even addressing the potential value of a space-based interceptor layer, why does the country seem to be lagging behind in the deployment of critical space sensors? It is certainly not for technology reasons. The country has the engineers, scientists, and technology solutions to fully utilize the space environment for this mission, not only to detect and track missiles launched on earth, but also to base interceptors or leverage that domain to accomplish kinetic and non-kinetic space engagements.[5] Yet in missile defense, the country is still not much farther beyond where it was—in terms of how it leverages the space domain for this mission—some 30 years ago.

Today's Use of Space for Missile Defense

In Desert Storm, it became apparent that space assets and space control would become ever more critical to U.S. conventional warfighting.[6] Yet the primary uses of space since the 1991 Persian Gulf War continue to be leveraging satellites to detect missile launches, facilitate global communications, and provide positioning, navigation, and timing data to missile defense

systems. In one notable advance since then, the country recently deployed Spacebased Kill Assessment sensors for the homeland missile defense mission to inform the Warfighter whether an intercept has eliminated the target or whether the target needs to be reengaged.[7] MDA also has made progress in using overhead sensors and algorithms to detect and track advanced missile threats.[8]

Space provides the best viewpoint for addressing missile threats, including threats posed by hypersonic glide vehicles, which might begin their flight on a ballistic trajectory before moving into a glide and maneuvering phase. Space-based sensors are essential for detecting threat launches in boost phase from within adversary countries. A space-based sensor layer would enable the United States to use interceptor inventory more efficiently and effectively to counter a broad array of threats.[9] Integrated by a robust Command and Control, Battle Management and Communication infrastructure, space and terrestrial sensors for tracking, discriminating, cueing and targeting ballistic missile threats can improve the performance of the MDS. Much as they have over the past 30 years, space platforms continue to be used primarily for detection and establishing an initial track using the Defense Support Program and Space Based Infrared System (SBIRS) High satellites in geosynchronous and highly elliptical orbits. These collections enable the Warfighter to detect a launch and predict the trajectory of the ballistic missile target.

Efforts to deploy "eyes" in space to enable global and persistent tracking of in-flight ballistic missile threats have been on-again off-again and, in the end, have not resulted in the deployment of an operational constellation. The Space Surveillance and Tracking System program and Brilliant Eyes program (part of the Global Protection Against Limited Strikes architecture) were started by the Strategic Defense Initiative Organization to track and discriminate space objects. Brilliant Eyes was terminated by the Clinton Administration and replaced in 1994 by an Air Force-led effort called SBIRS Low, a proposed constellation of low earth orbit satellites to support National Missile Defense. SBIRS Low was transferred to MDA in 2001 and renamed in 2002 the Space Tracking and Surveillance System (STSS). The plan was to use STSS to deploy two satellites, which were launched in 2009, to perform sensor technology demonstrations and collect data useful for the development of follow-on systems. After some consideration was given to establishing a more robust STSS Follow-On program, plans shifted to the development of a Precision Tracking Space System (PTSS), a constellation focused on the regional threat (i.e., non-Russian, non-Chinese threats). The planned PTSS constellation, which would have covered most of the earth's landmasses along the equatorial belt, was terminated in 2013 for cost and questions about its long-term sustainability. With the ongoing passivation of the two STSS demonstrator satellites, which were never integrated into the operational MDS, the United States currently has no active and dedicated satellites on-orbit to track in-flight ballistic missiles.

What Space Can Offer

The potential advantages space offers missile defenders can be extraordinary. Space assets are critical for warfighting because they can perform a number of important functions. As discussed above, they can provide situational awareness and early launch warning. As the "bell-ringers" for the MDS, satellites do not require advanced warning of threat launches. Yet space sensors can do much more than this. A constellation of tracking satellites would be able to provide persistent birth to death coverage of threats by augmenting ground-based radar coverage and filling gaps in radar coverage, which would improve the overall performance and effectiveness of the MDS, especially if the threat is carrying midcourse countermeasures that also may be detected and tracked. Sensors on-orbit could track launches coming from the deep interiors of adversary states that are otherwise inaccessible to terrestrial sensors and they would eliminate both geographic basing constraints (i.e., outside of deploying radars on ships, a nation cannot populate the oceans with radars) and potential over-flight (i.e., diplomatic) issues. Space sensors would be able to watch threats coming from unexpected areas or flying on unexpected trajectories, and they would add robustness to the terrestrial sensor architecture.

Another major advantage of space sensors for missile defense is force protection. The more the sensor "center of gravity" moves to space, the more complicated and challenging it would be for an adversary to attack those assets. In other words, a proliferated constellation of satellites literally encircling the globe offers some built-in protection. Attacking on-orbit space military assets would not be an easy thing for most nations, although a nation could also attack the heavily protected ground segment or the communication links of a space system. China and Russia have made strategic choices to develop their spacepower capabilities, to include conducting live anti-satellite tests in space and building capabilities that can damage or destroy U.S. space assets.[10] While such attacks can be executed by these near-peer nations, destruction of satellites would likely be viewed by the United States and other nations as a highly destabilizing move.

In an effort to leverage some of the obvious advantages space offers missile defenders, today the country is moving towards adding Hypersonic and Ballistic Tracking Space Sensor (HBTSS) satellites to its current constellations of dedicated early warning spacecraft. Driven primarily by the emerging hypersonic missile threat, HBTSS is different from the predecessor tracking space sensors named above because its sensors will stare downward to pick out and track missile targets against the "cluttered" background caused by the "warm" earth, rather than, like the STSS demonstration satellites, staring upwards against the "cold" background of space (ideal for viewing ballistic missiles in midcourse flight). Once deployed, probably around the middle part of this decade, HBTSS will be part of the Space Force unified space architecture and provide a persistent, global capability to detect and track dim boosting ballistic missiles, hypersonic glide vehicles, as well as missile raids.[11]

This novel tracking system will contribute to regional missile defense against stressing threats, providing fire-control quality tracking data on hypersonic and ballistic threats for hand-over to missile defense sensors for engagement.[12] According to the MDA Director, VADM Jon Hill, "That's how we handle the global maneuver problem. If you don't have a sensor, tracking from launch all the way through demise, there's a period of uncertainty in that track. And what we don't want to do is launch a weapon that then opens a seeker and there's nothing there, because the target has maneuvered."[13] HBTSS will be a critical asset for the mission to destroy hypersonic missile threats in the glide phase of their flight, before they get to the terminal phase where they can begin to undertake maneuvering that will stress missile defenses. MDA plans to launch two proto-type demonstration satellites developed by different industry teams in 2023.

Uncertain Future?

The question is, and it is a legitimate question based on the past performance of the Defense Department and different administrations with the proposed spacecraft noted above: will HBTSS survive to become an acquisition program that leads to an operational constellation? Congress, the source of appropriations, is supportive now. One must ask, will other spending priorities knock HBTSS out of orbit in the outyears? Assuming a new administration takes over in 2025, will the next President put the weight of the office behind the program, or kill it in its infancy? Unless the Biden administration and Defense Department put a major emphasis on educating stakeholders, the American public, and American allies on the critical importance of these tracking satellites to the hypersonic and ballistic missile defense missions, it would be naïve to assume that it survives.

In addition to education, advocacy within the government must maintain an edge. There is a constant battle within the Pentagon bureaucracy for resources, and battles to save or terminate programs take place every year. The risk of termination is always there. One advantage HBTSS has that the past tracking sensor satellite programs lacked is a military service committed to the development and maturation of U.S. spacepower. Today, the Space Force and U.S. Space Command have a special charge that can naturally evolve into advocacy for space assets required to protect the country against emerging threats. In a sense, the country has "graduated" to the next level with the introduction of a Space Force that could have a big stake in HBTSS development. With the absorbing of the Space Development Agency into the Space Force, the Department of the Air Force has already come out strong in declaring its commitment to the low earth orbit transport layer and tracking layer (i.e., HBTSS) for the hypersonic missile defense mission.[14]

Yet there is still much more to do. Without even getting in the debate that has raged over the potential contributions of a space-based interceptor layer, one may anticipate future areas of friction even in the space sensor world. The United States still does not have a constellation of

tracking and discrimination satellites to provide vital persistent discrimination and tracking data on a ballistic missile's midcourse flight, and missile defenders are constrained by relying on ground- and sea-based radars to provide critical information to the MDS on midcourse countermeasures.

Simply put, the greatest leap in capability that can be achieved in the MDS is when a space layer is added. It buys mission response time globally.[15] A truly layered defense system creates intercept opportunities in boost or ascent phase, the midcourse phase, and the terminal phase of a ballistic missile's flight. A space sensor network, composed of satellites that perform the same functions as the recently retired demonstrator STSS satellites would fill a critical sensor gap between boost phase and the terminal phase, a time during a ballistic missile's flight when an adversary is most likely to deploy countermeasures and decoys to try to confuse the radars during the terminal and midcourse phases of flight. Layered defenses leveraging different sensors can provide the MDS improved "vision"—the ability to see, track, and discriminate—by deploying sensors in multiple environments along the path of a threat missile. This must be the Defense Department's next consideration.

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