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Hypersonic Missile Defense: Issues for Congress

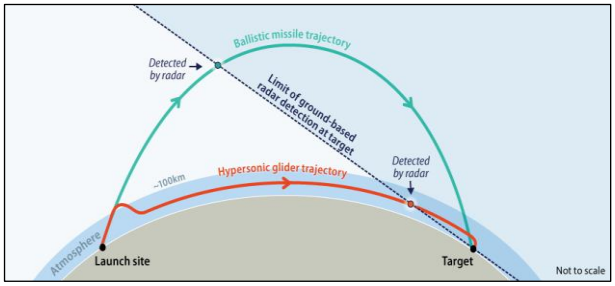
The Missile Defense Agency (MDA) and Space Development Agency (SDA) are currently developing elements of a hypersonic missile defense system to defend against hypersonic weapons and other emerging missile threats. These elements include the tracking and transport layers of the Proliferated Warfighter Space Architecture (PWSA) and various interceptor programs. As MDA and SDA continue to develop these systems, Congress may consider implications for oversight and defense authorizations and appropriations.

Background

Hypersonic weapons, like ballistic missiles, fly at speeds of at least Mach 5, or roughly 1 mile per second. Unlike ballistic missiles, hypersonic weapons do not follow a ballistic trajectory and can maneuver en route to their target. Russia reportedly fielded its first hypersonic weapons in December 2019, while some experts believe that China fielded hypersonic weapons as early as 2020. The United States does not have any fielded hypersonic weapons. (For an overview of hypersonic weapons programs in Russia, China, and the United States, see CRS Report R45811, *Hypersonic Weapons: Background and Issues for Congress*, by Kelley M. Sayler.)

The maneuverability and low flight altitude of hypersonic weapons could challenge existing detection and defense systems. For example, most terrestrial-based radars cannot detect hypersonic weapons until late in the weapon's flight due to line-of-sight limitations of radar detection. This leaves minimal time for a defender to launch interceptors that could neutralize an inbound weapon. **Figure 1** depicts the differences in terrestrial-based radar detection timelines for ballistic missiles versus hypersonic weapons.

Figure 1. Terrestrial-Based Detection of Ballistic Missiles vs. Hypersonic Weapons



Source: CRS image based on an image in "Gliding missiles that fly faster than Mach 5 are coming," *The Economist*, April 6, 2019, https://www.economist.com/science-and-technology/2019/04/06/gliding-missiles-that-fly-faster-than-mach-5-are-coming.

U.S. defense officials have stated that both existing terrestrial- and space-based sensor architectures are insufficient to detect and track hypersonic weapons; former Under Secretary of Defense for Research and Engineering Mike Griffin has noted that "hypersonic targets are 10 to 20 times dimmer than what the U.S. normally tracks by satellites in geostationary orbit."

Proliferated Warfighter Space Architecture

SDA developed the PWSA, formerly known as the National Defense Space Architecture, to "unify and integrate next generation capabilities across [the Department of Defense (DOD)] and industry." According to SDA, the PWSA aims to be a "single, coherent proliferated space architecture with seven layers," which include the data tracking and transport layers depicted in

Figure 2 and discussed below. Other layers include the *custody layer* to support the targeting of mobile ground assets; the *battle management layer* to provide space-based command and control; the *navigation layer* to provide "alternate positioning, navigation, and timing for potential GPS-denied environments"; the *deterrence layer* to detect potentially hostile actions in deep space; and the *support layer* to facilitate satellite operations for the other PWSA layers. Once fully fielded, the PWSA is to include 550 satellites and provide full global coverage.

Tracking Layer

SDA states that the tracking layer is to "provide global indications, warning, tracking, and targeting of advanced missile threats, including hypersonic missile systems." As part of this layer, SDA is developing an architecture of Wide Field of View (WFOV) satellites, which are to eventually provide global coverage. SDA requested $108.7 million for Tranche 0 tracking activities in FY2025 and $1.5 billion for Tranche 1 tracking activities (also known as Resilient Missile Warning Missile Tracking - Low Earth Orbit).

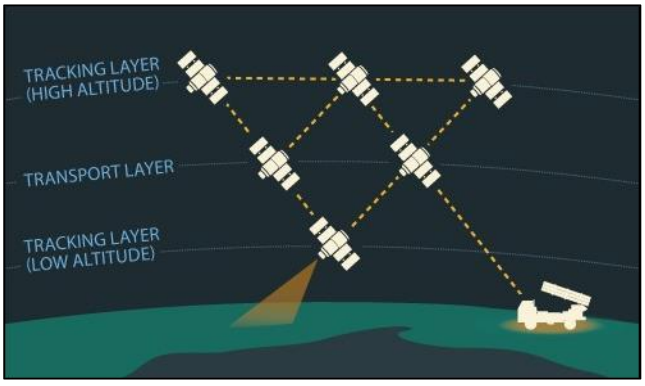
Working in tandem with the SDA's tracking satellites will be the Hypersonic and Ballistic Tracking Space Sensor (HBTSS), previously known as the Space Sensor Layer, which is being developed by MDA in collaboration with SDA and the U.S. Space Force. HBTSS is to provide more sensitive, but more limited (or Medium Field of View [MFOV]) coverage, compared to WFOV. For this reason, WFOV is intended to provide cueing data to HBTSS, which could then provide more specific, target quality data to a ground-based interceptor. MDA requested $76 million for HBTSS in FY2025.

The Space Force's Space Systems Command (SSC) is developing a third set of tracking satellites called Resilient Missile Warning Missile Tracking - Medium Earth Orbit (MEO). According to SDA, the MEO satellites will add "low-latitude coverage and track custody" and enhance resilience in the nation's missile defense architecture. The

Space Force requested $846.3 million for Resilient Missile Warning Missile Tracking - MEO in FY2025.

Section 1682 of the FY2020 NDAA (P.L. 116-92) tasks the director of the Missile Defense Agency to "develop a hypersonic and ballistic missile tracking space sensor payload." Section 1645 of the FY2021 NDAA (P.L. 116-283) requires that integration of the sensor payload into the SDA's broader space-based sensor architecture begin "as soon as technically feasible." In 2022, the Space Force established a Combined Program Office to coordinate missile warning and tracking efforts, including SDA's PWSA, MDA's HBTSS, and SSC's MEO satellites.

Figure 2. Selected Elements of the PWSA



Source: CRS image; not to scale.

Transport Layer

SDA has stated that the PWSA's transport layer, which is intended to connect the tracking layer to interceptors and other weapons systems on the ground, will "enhance several mission areas including missile defense." According to DOD, SDA has awarded prototype agreements for Tranches 1 and 2 of the transport layer. The transport layer is to eventually consist of a constellation of approximately 300-500 satellites. SDA requested $1.4 billion for "the data transport layer, sensor capabilities, and alternate position, navigation, and timing capabilities" in FY2025.

Interceptors

MDA has explored options for neutralizing hostile hypersonic weapons, including interceptor missiles, hypervelocity projectiles, directed energy weapons, and electronic attack systems. In January 2020, MDA issued a draft request for prototype proposals for a Hypersonic Defense Regional Glide Phase Weapons System interceptor. This program was intended to "reduce interceptor key technology and integration risks." In April 2021, MDA then shifted to the Glide Phase Interceptor (GPI), which is to be integrated with the Aegis Weapon System. Although GPI was to notionally provide a hypersonic missile defense capability in FY2034, Section 1666 of the FY2024 NDAA (P.L. 118-31) directs DOD to achieve initial operational capability for the program by December 31, 2029, and full operational capability by December 31, 2032. Lockheed Martin, Northrop Grumman, and Raytheon Missiles and Defense have been awarded contracts for the "accelerated concept design" phase of the GPI. In May 2024, DOD signed a formal agreement with Japan to cooperatively develop GPI.

In addition, Section 1664 of the FY2022 NDAA (P.L. 117-81) grants the director of MDA "the authority to budget for, direct, and manage directed energy programs applicable" for hypersonic missile defense, while Section 1662 of the FY2023 NDAA (P.L. 117-263) directs MDA to produce a strategy to use asymmetric capabilities (e.g., directed energy, microwave systems) to defeat hypersonic missile threats. The Defense Advanced Research Projects Agency (DARPA) is also working on a program called Glide Breaker, which is to "develop critical component technology to support a lightweight vehicle designed for precise engagement of hypersonic threats at very long range." DARPA requested $38 million for Glide Breaker in FY2025. Overall, MDA requested $182 million for hypersonic defense in FY2025.

Issues for Congress

Some analysts have suggested that space-based sensor layers—integrated with tracking and targeting systems to direct high-performance interceptors or directed energy weapons—could theoretically present viable options for defending against hypersonic weapons. The 2019 Missile Defense Review notes that "such sensors take advantage of the large area viewable from space for improved tracking and potentially targeting of advanced threats, including hypersonic [weapons]." Other analysts have questioned the affordability, technical feasibility, and/or utility of hypersonic weapons defense. In addition, some analysts have argued that the United States' current command and control architecture would be incapable of "processing data quickly enough to respond to and neutralize an incoming hypersonic threat."

Some analysts have also questioned the current division of labor and level of coordination between the SDA and MDA on hypersonic missile defense. SDA director Tournear has previously responded to criticisms of potential redundancies between the two agencies, stating that both report to the Under Secretary of Defense for Research and Engineering. Since October 2022, SDA director Tournear instead reports to the Assistant Secretary of the Air Force for Acquisition and Integration. Also in 2022, the Space Force created the combined program office overseeing missile warning and tracking efforts to address concerns about integration. Congress may monitor the implications of this reporting structure and new combined program office for efficiency and efficacy.

Potential Questions for Congress

- Is an acceleration of research on hypersonic missile defense options both necessary and technologically feasible? Does the technological maturity of hypersonic missile defense options warrant current funding levels?
- How are SDA, MDA, and SSC collaborating on various elements of hypersonic missile defense? Are their current roles increasing or decreasing costs and the speed and efficiency of technology development?
- Does DOD have the enabling capabilities, such as adequate command and control architectures, needed to execute hypersonic missile defense?

Jennifer DiMascio, Analyst in U.S. Defense Policy
Kelley M. Sayler, Analyst in Advanced Technology and Global Security

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