

Updated May 15, 2025

Hypersonic Missile Defense: Issues for Congress

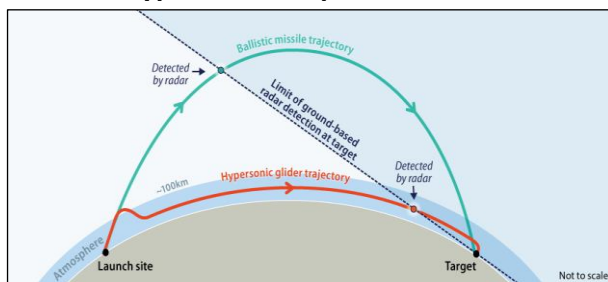
The Missile Defense Agency (MDA) and Space Development Agency (SDA) are currently developing elements of a missile defense system that may be able to defend against hypersonic weapons and other emerging missile threats. These elements include the tracking and transport layers of the Proliferated Warfighter 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 China likely fielded hypersonic weapons as early as 2020.

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>.

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.”

The Proliferated Warfighter Space Architecture

According to SDA, the PWSA, formerly known as the National Defense Space Architecture, aims to be a “resilient

layered network of military satellites and supporting elements,” which include the data tracking and transport layers depicted in **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 to more than 500 satellites. SDA requested \$1.4 billion for the “data transport layer, sensor capabilities, and alternate position, navigation, and timing ... capabilities” in FY2025.**

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 GPS-independent positioning, navigation, and timing; 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 provide 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 \$1.7 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. 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. A March 2025 MDA and U.S. Navy test demonstrated that HBTSS data could “detect, track, and perform a simulated engagement” of a maneuvering hypersonic target.

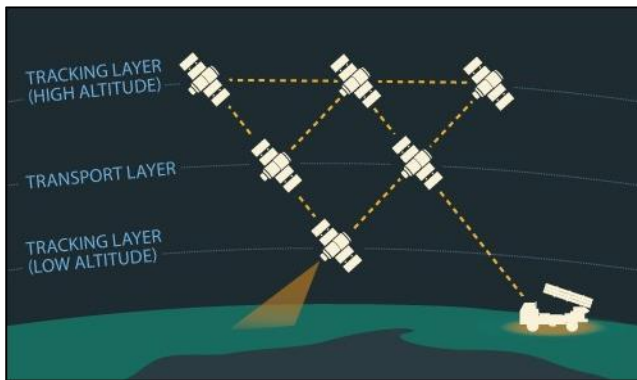
The Space Force’s Space Systems Command (SSC) is developing a third set of tracking satellites called Resilient Missile Warning Missile Tracking - Medium Earth Orbit (MEO). According to SDA, the MEO satellites will add “low-latitude coverage and track custody” and enhance resilience in the nation’s missile defense architecture. The Space Force requested \$846.3 million for Resilient Missile Warning Missile Tracking - MEO in FY2025.

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.

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 to more than 500 satellites. SDA requested \$1.4 billion for the "data transport layer, sensor capabilities, and alternate position, navigation, and timing ... capabilities" in FY2025.

Figure 2. Selected Elements of the PWSA



Source: CRS image; not to scale.

Interceptors

MDA has explored options for neutralizing hostile hypersonic weapons, including interceptor missiles, hypervelocity projectiles, directed energy weapons, and electronic attack systems. The agency is currently pursuing the Glide Phase Interceptor (GPI), which is to be integrated with the Aegis Weapon System. Section 1666 of the FY2024 NDAA (P.L. 118-31) directs DOD to achieve initial operational capability for GPI by December 31, 2029, and full operational capability by December 31, 2032, though reports indicate that delivery may be delayed to 2035. In May 2024, DOD signed a formal agreement with Japan to cooperatively develop GPI. In September 2024, MDA announced that Northrop Grumman would 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 and demonstrate "a propulsion technology to support a lightweight vehicle designed for hit-to-kill engagement of hypersonic threats at very long range." DARPA requested \$38 million for Glide Breaker in

FY2025. Overall, MDA requested \$182 million for the hypersonic defense program element in FY2025.

"Golden Dome for America"

The Trump Administration's January 27, 2025, executive order "The Iron Dome for America" directs the Secretary of Defense to submit to the President "plans for defense of the United States against ballistic, hypersonic, advanced cruise missiles, and other next-generation aerial attacks from peer, near-peer, and rogue adversaries." As part of this effort, the Secretary is to outline plans for the acceleration of the deployment of HBTSS, the development and deployment of the custody layer of PWSA, and the development and deployment of space-based interceptors and non-kinetic capabilities, among other activities. In February 2025, the executive branch redubbed the project "Golden Dome for America." (See CRS Insight IN12544, *The Golden Dome (Iron Dome) for America: Overview and Issues for Congressional Consideration*, by Hannah D. Dennis.)

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 division of labor and level of coordination between SDA and MDA on hypersonic missile defense. Similarly, observers have noted potential challenges with transitioning mature programs from SDA and MDA to the Space Force.

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? What additional capabilities, if any, will it need to enable the Administration's proposed "Golden Dome for America"?
- How might forthcoming "Golden Dome" plans incorporate or otherwise affect existing hypersonic missile defense programs?
- How does DOD plan to transition operation of hypersonic missile warning and tracking satellites and associated support equipment from SDA and MDA to

the military? Is DOD budgeting for such a transition? To what extent will DOD rely on contractors for operations?

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IF11623

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