SF254-D1207: Affordable IR Sensors for Proliferated LEO Missile Tracking Constellation

ADDITIONAL INFORMATION
N/A

TECHNOLOGY AREAS:
Space Platforms

MODERNIZATION PRIORITIES:
Space Technology

KEYWORDS:
infrared sensors; MWIR; IR; Infrared; missile detection; missile tracking; radiation tolerance; detection latency; manufacturability; PWSA; Tracking Layer; pLEO

OBJECTIVE:
The United States Space Force (USSF), through the Space Development Agency (SDA), seeks to develop and mature affordable, high-performance midwave infrared (MWIR) sensor technologies for space-based missile detection, tracking, and defense. This effort aims to deliver a complete sensor prototype that demonstrates performance characteristics—such as sensitivity to missile plumes, radiation tolerance for extended LEO operations, and suitability for small satellite platforms—while achieving significant cost reductions. These reductions should be realized through innovative materials, manufacturing processes, and/or sensor architecture approaches, enabling scalable production and integration into the Proliferated Warfighter Space Architecture (PWSA) and other next-generation missile warning constellations.

ITAR:
The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

DESCRIPTION:
The United States Space Force (USSF), through the Space Development Agency (SDA), is developing the Proliferated Warfighter Space Architecture (PWSA)—a resilient, threat-driven constellation in Low Earth Orbit (LEO) designed to deliver global missile warning, tracking, and data transport capabilities. The Tracking Layer of the PWSA relies on infrared (IR) sensors to detect and track advanced missile threats, including ballistic and hypersonic systems.

Current IR sensor technologies are often too costly, complex, or power-intensive to be deployed affordably and at scale in proliferated LEO constellations. To address this challenge, this topic seeks innovative, affordable MWIR (midwave infrared) sensor solutions that retain or improve upon state-of-the-art performance while significantly reducing cost and complexity. Target capabilities include:
- MWIR operation in the 3–5 μm band
- Sensitivity and noise performance sufficient for missile plume detection
- Radiation tolerance for at least five years in LEO
- Compatibility with smallsat constraints (mass, size, power, and bandwidth)
- Prototype readiness for further maturation and eventual on-orbit demonstration
- Projected unit production cost at least 30% lower than current comparable space-qualified IR sensors, supported by preliminary supply chain and manufacturing analysis

Offerors may propose novel or proven approaches but must deliver a working prototype achieving Technology Readiness Level (TRL) 5 or higher by the end of Phase II. Emphasis will be placed on designs that improve

manufacturability, leverage innovative materials or architectures, and support large-scale deployment across SDA and DoD missile tracking missions.

PHASE I:

This topic is intended for technology proven ready to move directly into Phase II. Therefore, Phase I awards will not be made for this topic. The applicant is required to provide detail and documentation in the Direct-to-Phase-II (D2P2) proposal which demonstrates accomplishment of a "Phase I-type" effort, including a feasibility study. This includes determining, insofar as possible, the scientific and technical merit and feasibility of ideas appearing to have commercial potential. It must have validated the product-mission fit between the proposed solution and a potential U.S. Air Force (USAF) and/or USSF stakeholder. The applicant should have defined a clear, immediately actionable plan with the proposed solution and the U.S. Department of Air Force (DAF) customer and end-user. The feasibility study should have:

1. Clearly identified the potential stakeholders of the adapted solution for solving the USAF and/or USSF need(s).
2. Described the pathway to integrating with DAF operations, to include how the applicant plans to accomplish core technology development, navigate applicable regulatory processes, and integrate with other relevant systems and/or processes.
3. Describe if and how the solution can be used by other U.S. Department of Defense (DoD) or Governmental customers.

PHASE II:

Phase II will focus on the development, fabrication, and demonstration of affordable midwave infrared (MWIR) sensor prototypes that maintain high-performance detection and tracking capabilities while significantly reducing cost through innovative materials, manufacturing methods, and architectural designs.

Activities should emphasize design optimization for both technical performance and manufacturability, with specific attention to minimizing system complexity and identifying opportunities to transition toward scalable, cost-effective production. Offerors are expected to produce engineering prototypes that meet the required specifications for missile plume detection in Low Earth Orbit (LEO) and enable rigorous evaluation of affordability and manufacturability trade-offs. At a minimum, Phase II deliverables must include:
- Fabricated engineering prototype units
- A comprehensive test and verification data package validating key performance parameters (e.g., sensitivity, noise, radiation tolerance)
- A cost-reduction analysis with supporting trade studies addressing materials, fabrication processes, and supply chain considerations

Success criteria include:
- Achieving Technology Readiness Level (TRL) 5
- Demonstrating compliance with required size, weight, power, and data (SWaP-D) constraints for smallsat integration
- Presenting a credible, data-supported cost reduction pathway for future production and integration into SDA's Tracking Layer

Proposals should also account for manufacturing scalability and process optimization to support SDA's future PWSA deployment tranches and broader DoD missile tracking architectures.

PHASE III DUAL USE APPLICATIONS:

Phase III efforts will focus on transitioning the matured midwave infrared (MWIR) sensor technology into operational deployment across Department of Defense (DoD) space systems and relevant commercial applications. Building upon the prototype performance and manufacturing insights gained during Phase II, activities will emphasize:
- Scaled production readiness, including final design optimization and supply chain alignment
- System-level integration with SDA's Proliferated Warfighter Space Architecture (PWSA) Tracking Layer and other missile warning and tracking constellations
- Qualification for mission environments and compatibility with standardized small satellite platforms

Offerors should demonstrate a clear plan to support volume production at cost points that enable widespread fielding in future PWSA tranches. The Space Development Agency (SDA) will support transition pathways by

facilitating engagement with government acquisition offices, missile defense stakeholders, and prospective commercial partners interested in dual-use IR sensing applications (e.g., Earth observation, wildfire monitoring, industrial inspection). The goal of Phase III is to ensure the technology becomes a sustainable, mission-ready sensing capability that advances both national security and commercial market resilience through reliable, cost-effective space-based infrared tracking solutions.

REFERENCES:

1. Tracking Layer Factsheet, Space Development Agency (SDA). https://www.sda.mil/home/work-with-us/resources/.
2. Space Sensors and Missile Defense, Steve Lambakis, National Institute Press, 2023. https://nipp.org/wp-content/uploads/2023/08/Space-Sensors-2023.pdf.
3. JASON Report JSR-10-620, "MDA Discrimination," August 3, 2010. https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/MDA/16-F-1190_MDA_Discrimination_JSR-10-620_Aug-3-2010.pdf?ver=2017-05-16-145851-873.

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