Advanced Technology Program Overview



To: Huntsville Aerospace Marketing Association

Dr. Shari Feth Program Executive for Advanced Technology January 10, 2020

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To develop and deploy a layered Missile Defense System to defend the United States, its deployed forces, allies, and friends from missile attacks in all phases of flight





Missile Defense Evolving Threat Environment

Adversaries are fielding diverse and expansive ranges of modern offensive missile systems

- Developing new missiles & improving existing systems
 - Precision strike
 - Penetration aids (e.g. decoys, jamming devices)
- Capable of maneuvering in midcourse or terminal phase
 - Maneuvering Reentry Vehicle (MaRV)
 - Multiple Independent Reentry Vehicle (MIRV)
 - Hypersonic glide vehicles and cruise missiles



North Korea Hwasong-15 ICBM



China Dong Feng (DF-26) IRBM



Iran Emad-1 MRBM with MaRV



Russia Concept Hypersonic Glide Vehicle



Ref: 2019 Missile Defense Review



Missile Defense Agency Lines of Effort In Support Of The National Defense Strategy

 Build Warfighter confidence through focus on readiness and sustainment



- Increase engagement capability and capacity to outpace emerging threats
- Increase speed of delivery of new capability to address the evolving threat





Today's Missile Defense System Meets Today's Threat but Requires Additional Capacity and Advanced Capability to Outpace the Evolving Threat



Today's Layered Missile Defense System





Advanced Technology – What We Do "Innovators of Missile Defense Domination"

- Unique Program inside Missile Defense Agency (MDA)
 - Mission: Deliver advanced concepts and technologies to transform the Missile Defense System (MDS) and outpace the threat
- Pursue Innovative Concepts, Technologies and Materials for Specific Enhanced Capabilities
 - Disruptive technology push
 - Incremental advancements to achieve game changing capabilities
 - Innovative solutions to obsolescence
 - High pay-off, but potentially high risk
 - Develop technologies to support evolving warfighter needs through and beyond planned MDS increments



MDA's S&T Investment Strategy

- 1. Identify warfighter and future architecture needs
- 2. Review technology development program plans for viability and relevance
- 3. Identify gaps and disruptive technology opportunities
- 4. Build MDA Strategic S&T Roadmap
 - a. Prioritized and aligned with National Defense Strategy, Road to Dominance modernization and MDA lines of effort
- 5. Identify internal and external S&T investment opportunities
 - a. Leverage OSD programs (e.g. Rapid Innovation Fund, Communities of Interest, Applied Research for Advancement of Priorities)
 - b. Leverage collaboration with service communities and academia
- 6. Collaborate across warfighter community to advance MDA S&T Roadmap initiatives
- 7. Assign resources to support S&T initiatives
- 8. Develop rapid acquisition approaches
- 9. Accelerate technology transition to programs of record







Hypersonic Glide Vehicles (Notional)



Threat Reentry Vehicle (Notional)



Hypersonic Cruise Missiles (Notional)



Technology Identification Maturation

Approach for Advancing Emerging Technologies for Insertion Into Missile Defense System across Kill Chain

- Warfighter identifies needs in the Prioritized Capabilities List
- MDS architect develops Future Architecture Roadmap
- Directorate of Engineering and Advanced Technology Program Executive Office jointly identify technology gaps
- Independently assesses other gaps and technology push opportunities
- Prioritizes technology development needs and documents in Science and Technology Roadmap
- Informs budget process

Technology Insertion Process

Technology Readiness Level (TRL) 1- 3	TRL 4- 5	TRL 6+		
Small Business Academia				
Initiate new emerging concept	Proof of concept and technology demonstration	Demonstrate prototype in relevant and operational environment, complete system and qualify through demo and test, and prove system with mission operations		Element Transition
Industry Partners			_	
Warfighter and program offic	e participation increases	with advancements in TRL		



Advanced Technology

Advanced Technology Covers Two Broad Areas

Development of Advanced Technologies

- Inventing something new
- Researching or developing new concepts so they can be used for a specific purpose

Novel or advanced integration of known technologies

- Adapting known technologies for a new purpose
- Using technologies developed elsewhere to apply to a current mission or to address a current need



Fiber Combining Laser



Moth Eye



Development of Advanced Technology

Focused on Lower Technology Readiness Level (TRL) (1-4) Concepts

- Advanced research
- Science and Technology Council
- Science, Technology, Engineering and Math (STEM)

Recent Successes





Optical Materials for Space Testing

Diode Pumped Alkali Laser

- \$91M FY 2019 Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR) Budget (to date 141 awards and 75 pending), invested in missile defense relevant technologies
- Demonstrated feasibility of additively manufacturing optical structures with silicone carbide; trials completed with multiple powders and varied processes
- Integrated SBIR Phase III radiation-hardened mirrors into an experiment fixture in preparation for a space flight campaign
- Completed installation of a custom chemical vapor deposition furnace for fabrication of prototype zinc sulfide internally cooled seeker windows
- Completed industry laser scaling Critical Design Reviews Technology, September 2019

Planned Investments

- Continued evolution of the Science and Technology Roadmap and participation in the DoD Communities of Interest to include exploiting both to optimize MDA investments in technology development
- Transition of laser scaling and fiber combined laser initiatives from MDA and FFRDCs to industry
- Sustained development of the ruggedized advanced sensor laser for a pod-mounted weapon system
- Testing and launch of the Nanosat Testbed Initiative
- Development and assessment of hypersonic defense component technologies



Novel or Advanced Integration of Known Technologies

Focused on Higher TRL Concepts and Systems

- Sensor and laser technology
- Weapon system technology
- Advanced concepts and performance assessments

Recent Successes



Hypersonic Glide Vehicle (Notional)

- Awarded 5 contracts for Hypersonic Defense Weapon System (HDWS) Concept Definition Phase II to refine HDWS concepts and provide analysis that will inform Regional Glide Phase Weapon System prototype development and technology demonstrator flight test by mid 2020s
- Hosted industry day to solicit prototype concept proposals for the Regional Glide Phase Weapon System
- Awarded micro electro-mechanical system (MEMS) thruster contract
- Collaborated with DARPA on development of Glide Breaker system to counter hypersonic threats
- Transitioned Multi-Object Kill Vehicle technologies
- Supported multiple test events including FTG-11 and FLEX 19

Planned Investments

- Complete execution of HDWS Phase II contracts and exploit data to optimize Regional Glide Phase Weapon System investments and outpace the threat
- Award multiple contracts for Regional Glide Phase Weapon System prototype development by 4Q FY 2020 via Other Transactional Authority
- Develop modeling, simulation, algorithm and analysis techniques to validate evolving weapon systems
- Integrate artificial intelligence/machine learning (AI/ML) autonomy algorithms with unmanned aerial vehicle flight software
- Facilitate integration of left-through-right-of-launch Missile Defense System operation



THAAD Flight Test



Weapon System Technology – Hypersonic Defense Weapon System



Mission: Study and Develop Kinetic Interceptor and Non-kinetic Weapon Concepts to Defeat Hypersonic Threat Vehicles



Advanced Research



applications for insertion into the MDS



Small Business Innovation Research Small Business Technology Transfer Summary

Focus

- Small Business Innovative Research (SBIR) explores innovative concepts pursuant to Public Law 106-554 (Small Business Reauthorization Act of 2000) and Public Law 107-50 (Small Business Technology Transfer Program Reauthorization Act of 2001)
- Mandates a two-phase competition for small businesses with innovative technology that can be commercialized
- SBIR and Small Business Technology Transfer (STTR) programs will develop new dual-use technology for future MDA MDS needs
- Dual-use means that the technology will be judged on the potential for future private sector investment both as a vehicle for reducing development time and cost, unit costs of new MDS technology, and as a route to national economic growth through new commercial products
- MDA will conduct competition, award, and manage the contracts
- Advanced Technology manages a perpetually evolving portfolio of ~500 technology development efforts

Accomplishments

• Invested in a broad range of technologies for MDS, to include hypersonics



Thruster Hot Fire Test



Nanosat Testbed Initiative





Sensor and Laser Technology

Focus

- Laser Scaling
- National Laboratory Laser Scaling
 - Diode Pumped Alkali Laser (DPAL)
 - Fiber Combining Laser (FCL)
- Industry Laser Scaling (ILS); formerly Low Power Laser Demonstrator (LPLD)

Accomplishments

- Successful Passive Sensor on unmanned aerial vehicle (UAV) participation in FTG-11 demonstrating Launch on Remote (LOR) engagement quality against multiple targets
- Conducted successful Laser Lethality Demonstration
- Aligned Laser Scaling to OUSD(R&E) Directed Energy Roadmap

Future

Transition National Laboratory Laser Scaling to industry



Diode Pumped Alkali Laser





Technology Concept Assessment Process

Structured Systems Engineering Approach to Technology Concept Assessment

- 1. Understand the physics and phenomenology of advanced concepts
- 2. Define advanced concepts that address emerging threats
- 3. Assess the performance of industry concepts
- 4. System of Systems performance assessments





Technology Interest Areas

- Interceptor Technology
 - Guidance, navigation, and control
 - Batteries and power systems
 - Advanced materials
 - High temperature 0
 - Lightweight 0
 - Seeker technology -
 - Radiation hardened technology
 - Deployment systems
 - Lightweight composites
 - Propulsion and control technologies
 - Improved specific impulse Ο

- Command and Control, Battle MDS Testing Management, and **Communications (C2BMC)**
 - Advanced tracking and discrimination algorithms
 - Command and control algorithms
- Low latency and secure communications
- Battlespace management
- Data fusion
- Warfighter training
- Joint track management
- Combat identification
- Network management
- AI/ML

Modeling and Simulation

- Lethality
- Battlespace environments
- Engagement
- Aerothermal environments
- Technology investment evaluation
- Test verification

- - Affordable targets
 - Scene generation
 - HWIL
 - Rapid analysis software toolkits
 - Predictive analysis and modeling
 - Range safety
 - Sensors
 - EO/IR and radar
 - Track and receive modules
 - FPAs 0
 - Signal and data processing algorithms
 - Radiation hardened technology
 - Telescopes and antennas
 - Windows and radomes



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 - Mission: Deliver advanced concepts and technologies to transform the MDS and outpace the threat
- Pursue Innovative Concepts, Technologies, and Materials
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Closing

MDA remains steadfast in its commitment to advance the Agency's S&T initiatives to secure technological superiority in accordance with the Secretary of Defense and the National Defense Strategy.

