STELLAR TEAM NOBLE MISSION

Sensors and Directed Energy

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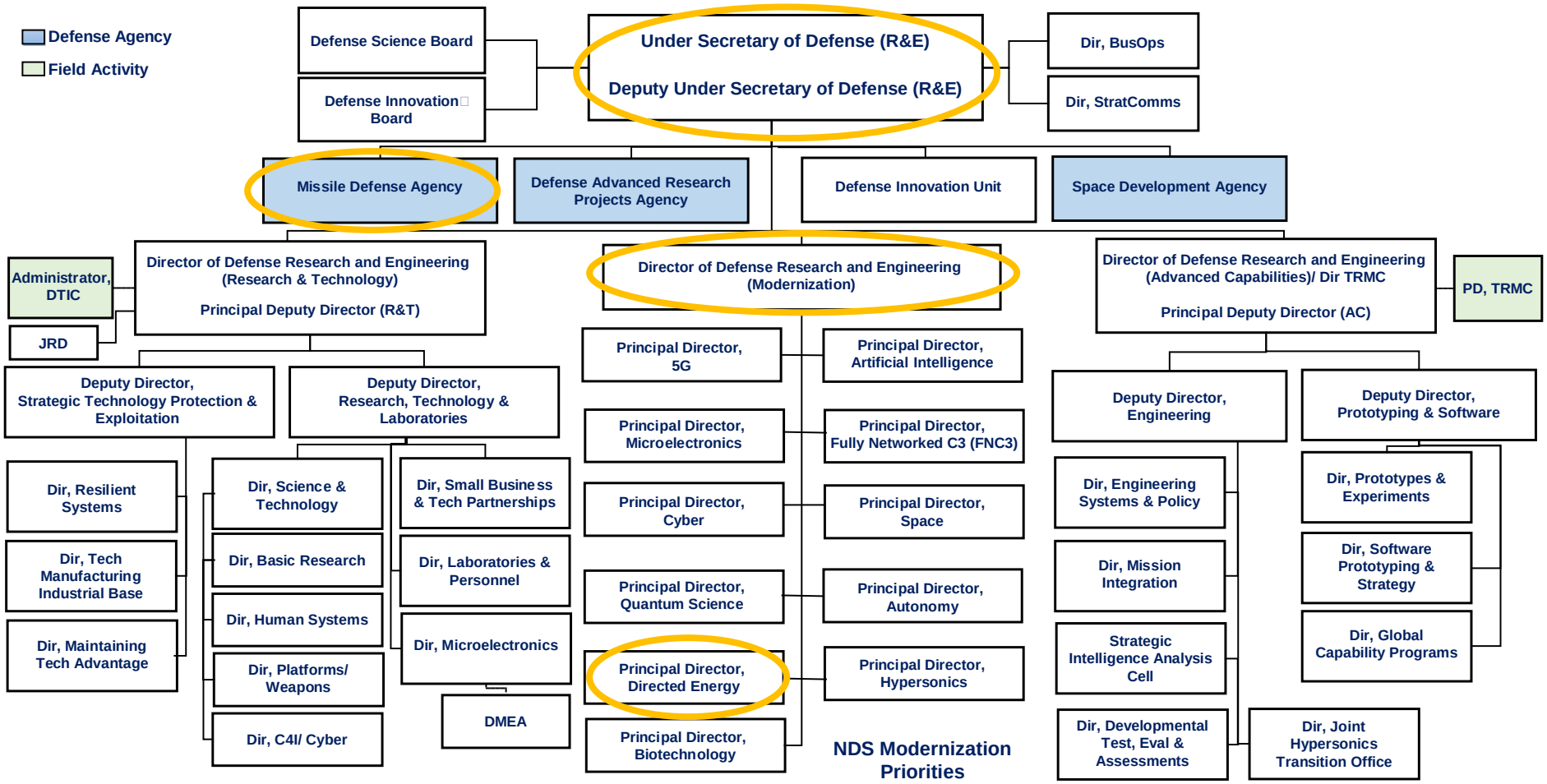
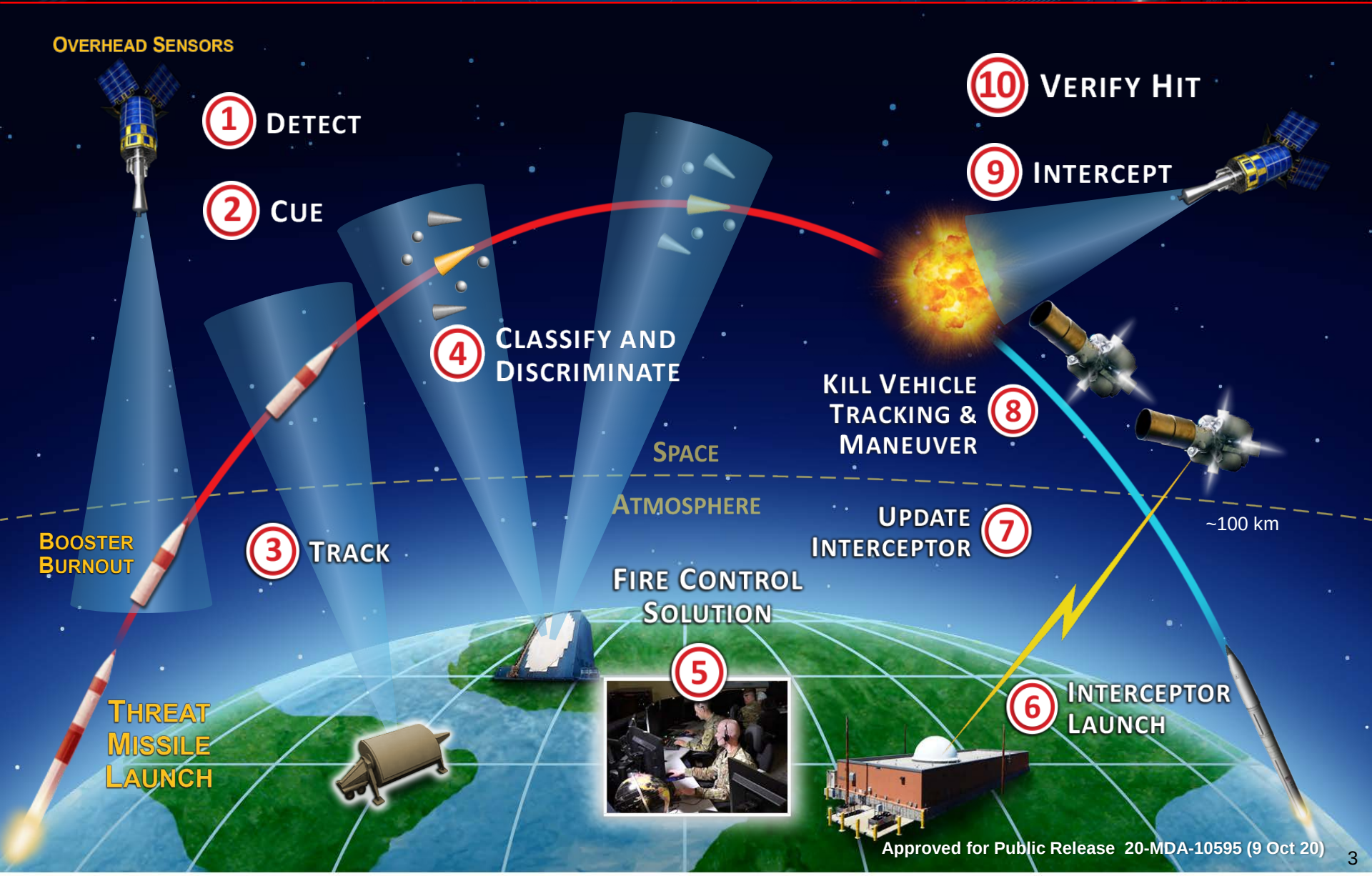
OUSD(R&E) Organizational Structure



10 Steps to Ballistic Missile Intercept



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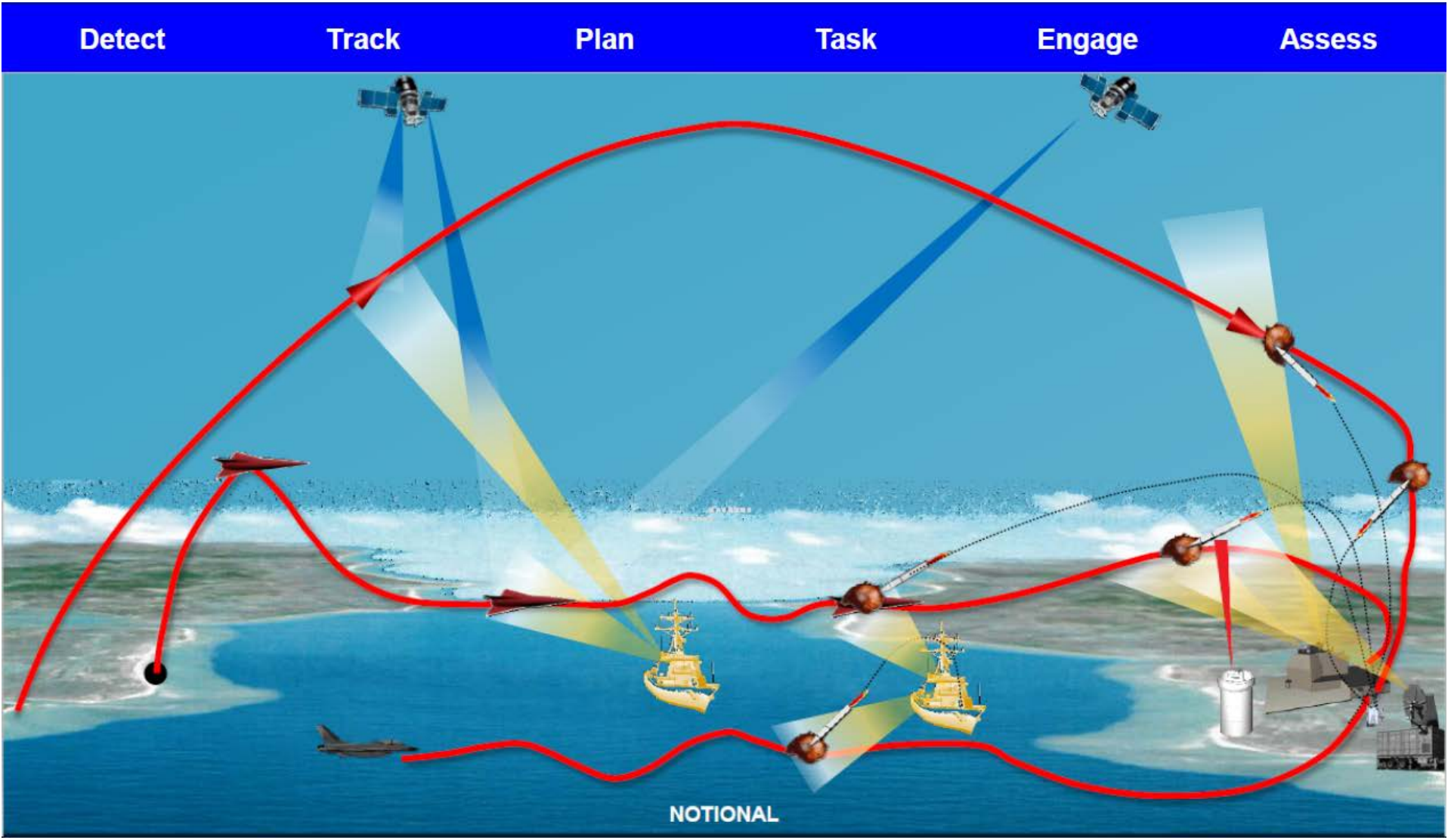
Directed Energy In Future Missile Defense



MDA Strategy

MDA's Directed Energy technology investment strategy is nested under the Office of the Under Secretary of Defense (OUSD) for Research and Engineering (R&E)'s Road Map

OUSD(R&E) Strategy:

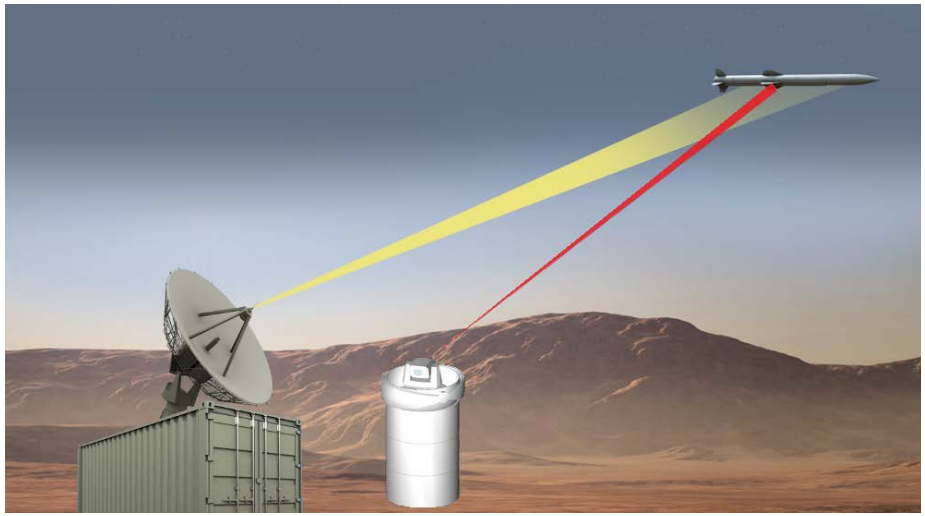
- Maintain competition in Industry
- Spiral developments
  - 300 kW-class laser builds currently underway
- Fastest possible deployment into the field

MDA Focus:

- Transition of National Laboratory technologies to Industry
- Missile Defense specific technologies
- Lethality assessments
- Developing Directed Energy Architecture for Missile Defense

Advantages of Directed Energy Weapon For Missile Defense

- Providing attack at the speed of light
- Precise targeting
- Rapid engagement of multiple targets
- Adjustable damage capacity
- Relatively low operational cost
- Reduced logistic support
- Relatively unlimited magazine
- Wide area coverage



Engage at the speed of light with increased magazine depth and decreased shot cost

Directed Energy Weapon Systems

High Powered Microwave(HPM)/Radio Frequency (RF) weapons

- Successful demonstrations conducted against softer targets
- MDA assisting lethality testing

Lasers

- Different technologies are at different levels of maturity
  - Effectiveness depends on operating environment. eg: Shorter wavelength of Diode Pumped Alkali Laser (DPAL) for high altitude or space application
- Too soon to down-select to just one technology
- Laser technologies under development include:
  - Pulsed lasers
  - Continuous Wave/High Energy laser

Current MDA focus is on competitive development (industry) and delivery of capability

MDA Technology Transition

MDA Technology Transition

General Atomics – Distributed Gain Laser (DGL)	With MDA Support, Achieved 100 kW – Class Performance in Oct 2019 and transitioned to the OUSD(R&E) Roadmap	In Progress: 300 kW – Class Build, Led by OUSD(R&E)
Lockheed Martin – Spectrally Combined Fiber Combined Laser (FCL)	With MDA Support, Achieved 100 kW – Class Performance in Oct 2019 and transitioned to the OUSD(R&E) Roadmap	In Progress: 300 kW – Class Build, Led by OUSD(R&E)
MIT Fiber Combined Laser	Boeing Development Contract	
Diode Pumped Alkali Laser	Pending Source Selection	

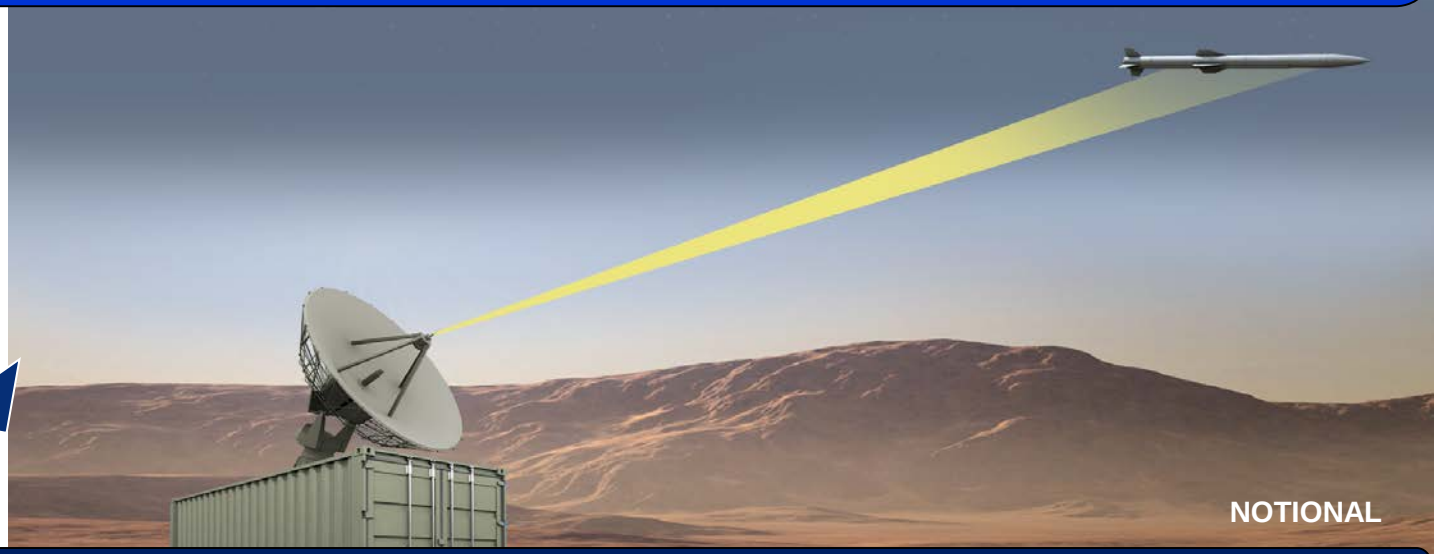
High Power Microwave (HPM) Technology Testbed

Program Capability Evolution

Current Plan

Develop and demonstrate Directed Energy Technology for Missile Defense

- **Complete HPM analysis**
- **Mature HPM technology that applies to MDA's mission**



Future Planned Activity/Program

Integrate Directed Energy into the Missile Defense System - enable speed of light engagement, increased magazine depth, lower shot cost

- Demonstrate viability for Missile Defense System
- Transition HPM Technology to a Non-Kinetic defeat weapons development program

Industry Laser Scaling (ILS)

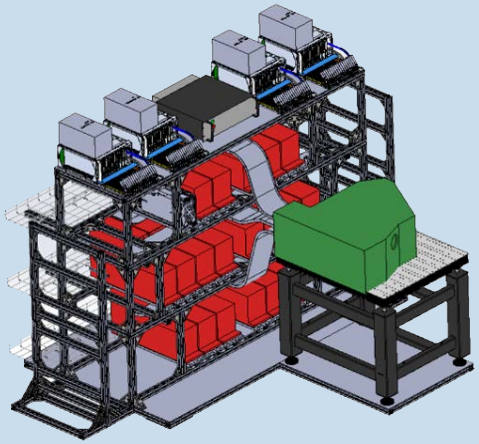
Capability Evolution

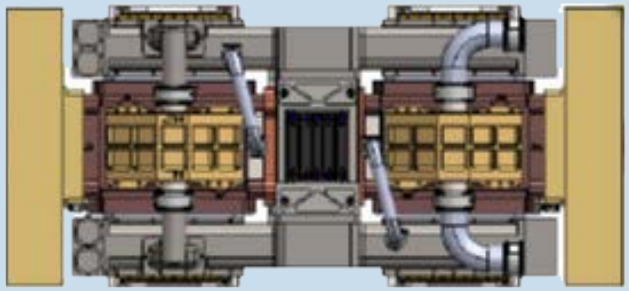
Current Plan

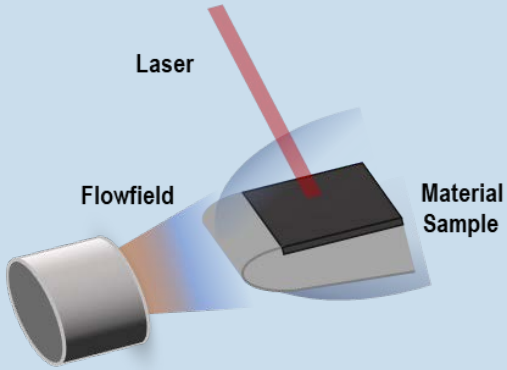
Coordinate with OUSD (R&E) to develop, adapt, and demonstrate OUSD(R&E) developed laser technologies for the missile defense mission

- Enable speed of light engagement, increased magazine depth, lower shot cost

CONCEPTUAL DESIGNS







Future Planned Activity/Program (OUSD R&E Initiatives)

- **Optimize electric lasers for size, weight, and power metrics and mature near diffraction limited beam quality**
- **Fiber Combined Laser (FCL)**
- **Industry Laser Scaling (ILS)**

Diode Pumped Akali Laser (DPAL)

Capability Evolution

Current Plan

Develop and demonstrate Directed Energy Technology for Missile Defense

- Mature Diode Pumped Alkali Laser (DPAL) system into a 60 kw-class laser and develop high fidelity models based on the design

Future Planned Activity/Program

- **Develop 60 kw-class laser and analyze to develop high fidelity models**
- **Mature models to reflect future growth potential/higher energy lasers**
- **Competitively transition laser development from national labs to industry**

Directed Energy: Missile Defense Specific Technologies

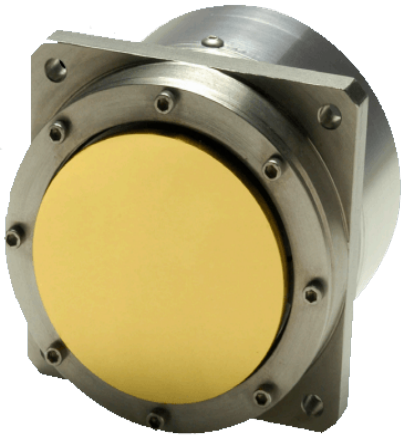
Capability Evolution

Current Plan

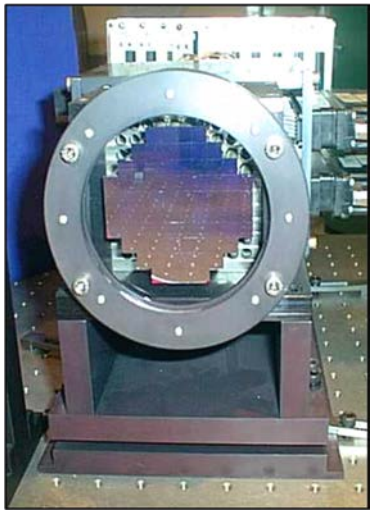
Develop and demonstrate Directed Energy Technology for Missile Defense

- Develop advanced optics, adaptive optics, and algorithms
- Partner with HELCAP
- Explore sensor enhancement

Prototype Beam Control



Prototype Fast Steering Mirror



Future Planned Activity/Program

Integrate Directed Energy into the Missile Defense System - enable speed of light engagement, increased magazine depth, lower shot cost

- Continue collaboration with wider Beam Control Community to maximize partnerships and minimize redundant efforts
- Solicit warfighter support to integrate laser capability with existing missile defense architecture

Directed Energy Lethality Assessment

Capability Evolution

Current Plan

Develop and demonstrate Directed Energy Technology for Missile Defense

- Development Vulnerability Module (VM)
- Conduct High Energy Laser (HEL) Probability of Weapon Effectiveness Experiment (PWEX)
- Lethality Testing with the Naval Surface Warfare Center (NSWC) Dahlgren
- Partner with Department of Energy (DoE) to support analysis

UNCLASSIFIED

Future Planned Activity/Program

- Develop VMs for MDA missions
- Maintain repositories of legacy test data; integrate data with the Department of Defense directed energy database
- Continue collaboration with Services and National Labs
- Continue lethality working group for both Kinetic (KE) and non-KE (nKE) effectors

Command, Control, Communications, and Missile Defense System (MDS) Integration

As Directed Energy systems evolve into an effective defensive capability, these capabilities can be integrated into the MDS via standard processes used for kinetic interceptor systems

Determine mission unique data required for the designated weapon system and the type of communication required

Integrate the system in wargames and exercises

Coordinate with:

- Military Services
- Regional and functional Combatant Commands, to include Indo-PACOM, NORTHCOM, CENTCOM, STRATCOM, and JFCC-IMD at a minimum
- Air and Integrated Missile Defense/Battle Management System

Establish Military Utility:

- Develop potential deployment/maintenance/training/employment plans and conduct studies to determine location and laydown

Begin Program Development

Summary

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