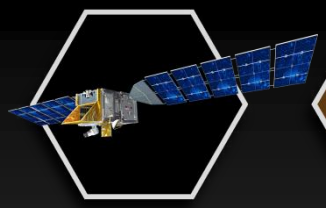
2017 Annual Missile Defense Small Business Programs Conference

Mr. Richard S. Matlock
Program Executive for Advanced Technology
Missile Defense Agency

June 21, 2017

Today's Ballistic Missile Defense System

Sensors


Satellite Surveillance

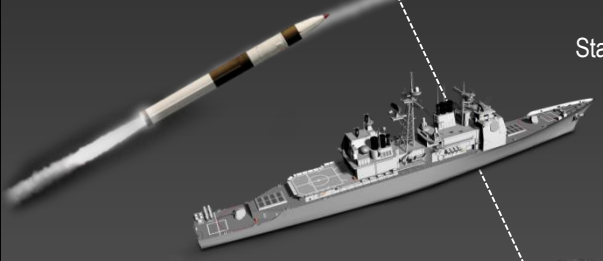

Forward-Based Radar


Upgraded Early Warning Radar


AEGIS BMD SPY-I Radar


Sea-Based X-Band Radar

BOOST / ASCENT Defense Segment



Aegis
Ballistic Missile Defense

SM-3
Standard Missile-3

Aegis Ashore

MIDCOURSE Defense Segment

GBI
Ground-Based Interceptor

TERMINAL Defense Segment

Aegis
Sea-Based Terminal

THAAD
Terminal High Altitude Area Defense

PAC-3
Patriot Advanced Capability-3

The System Of Elements

C2BMC Command Control, Battle Management and Communications

NMCC USSTRATCOM USNORTHCOM USPACOM USEUCOM USCENTCOM

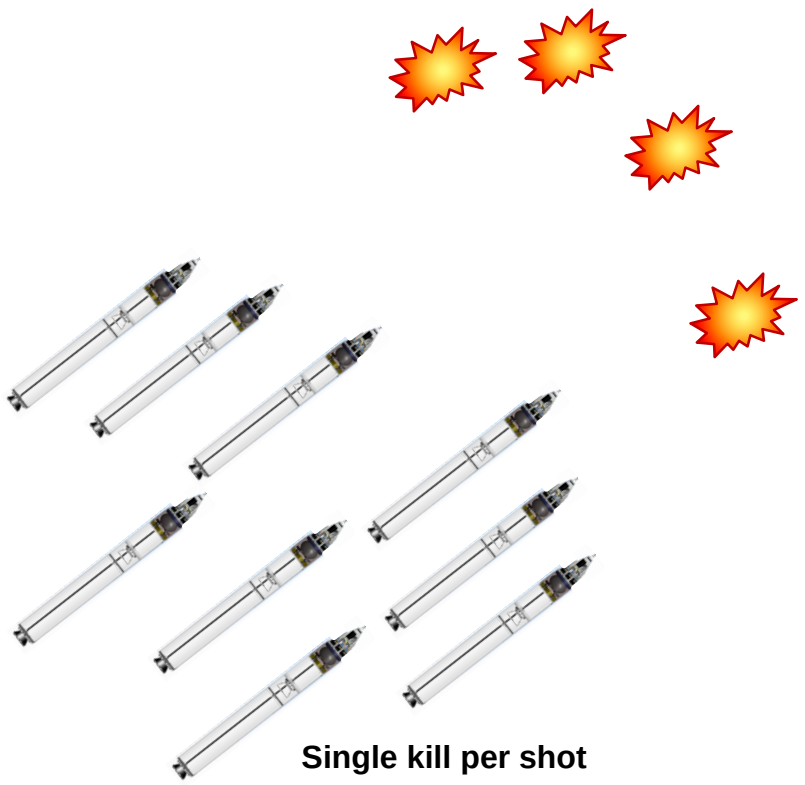
Transforming Missile Defense

Decrease Emphasis On:		Increase Emphasis On:
Fixed	→	Agile
Terrestrial	→	Space
Interceptors	→	Lasers
Right of Launch	→	Integrated Left & Right
Centralized Control	→	Autonomy
Prolonged Acquisition	→	Faster Refresh
Costly	→	Affordable

Invest in technology to revolutionize the BMDS and prove technology readiness through demonstrations

Multi-Object Kill Vehicle

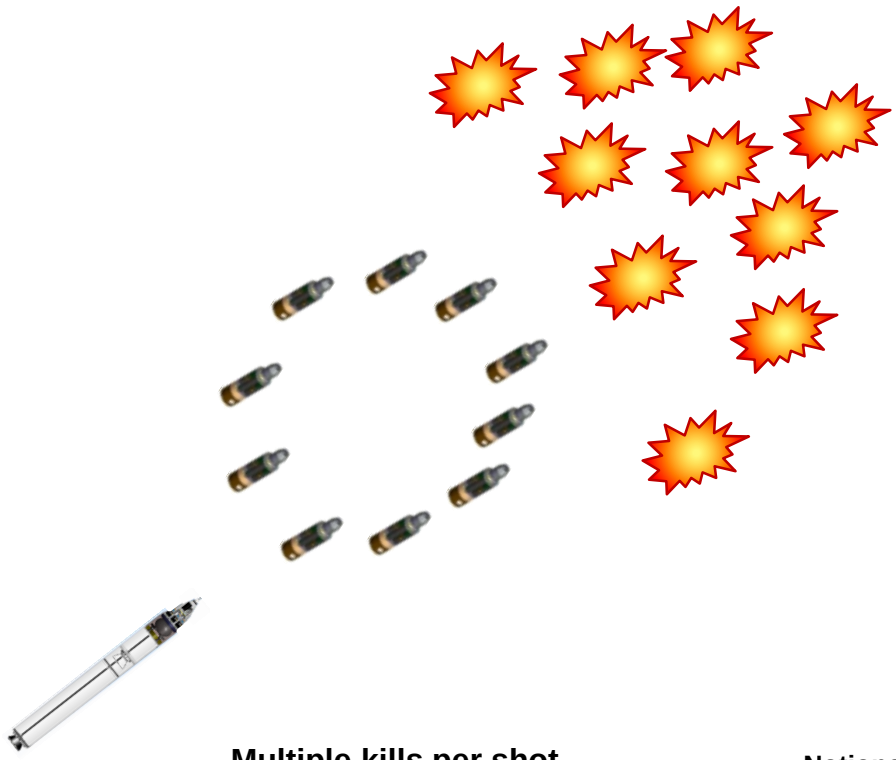
PRESENT



Single kill per shot

Notional

FUTURE



Multiple kills per shot

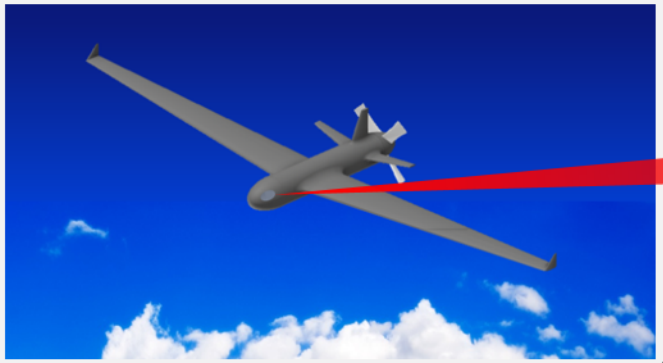
Notional

Multi-Object Kill Vehicle Enhances Midcourse Defense:
Destroy Lethal Objects With A Single Interceptor

Approved for Public Release
17-MDA-9222 (5 June 17)

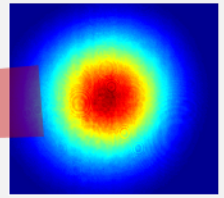
Next-Gen MDA Directed Energy Concept

High Altitude Unmanned Aerial Vehicle (UAV)
Fly in "Quiet" Stratosphere
Long Endurance – Days on Station



Above Clouds

High Efficiency
Beam Transmission to Target



- Low Speed
- Low Air Density
- Quiet airflow over platform

Low Optical and Mechanical Disturbances (Vibration/Jitter)

Clear – Low Atmospheric Turbulence

- Low Beam Divergence
- Precise Beam Stabilization

- Eliminate/minimize atmospheric compensation and active control loops
- Exploit advances in efficient, compact electric laser systems with rechargeable magazine

High Altitude UAV-borne Lasers for Boost Phase Kill

Demonstrate Precision Tracking

- **Two MQ-9 Reapers for stereo track**
- **Multi-spectral Targeting System, Type C (MTS-C) sensor with multiple cameras**
- **Unique airborne processor**
- **Forward chin mount to improve sensor field of view**

- **Extended range upgrades**
  - Larger wings (more fuel and lift)
  - Ice protection (higher altitude)

- **Incorporate tracking laser**
  - Single platform operations
  - Increased precision and range

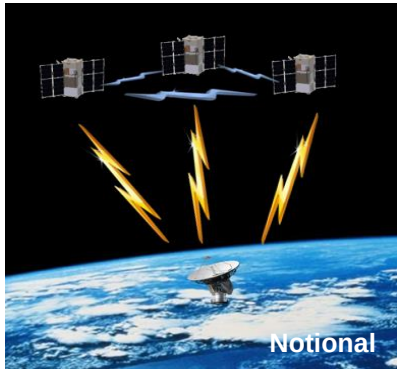
Demonstrate Acquisition & Tracking at Operational Ranges

NTI Experiment 1: Secure Radio Frequency Network Communications

Reduce communications risk for future weapon and sensor architectures: kill vehicle to kill vehicle, satellite to satellite, satellite to kill vehicle

- **NTI Experiment 1 Part A: CubeSat Networked Communications Experiment (CNCE)**
  - Networked Radio Frequency (RF) communications experiment using cluster of 3U CubeSats to flight test MDA developed Software Defined Radio (SDR)
  - Formation flying for separation meters to >100km
  - Performance metrics under non-optimal orientation
  - Launch by Air Force Space Test Program in 2018
- **Extended demonstration (~12 month) of Kill Vehicle (KV) communications technology at low cost**
  - Rapid Innovation Fund (2yr Period of Performance (PoP))
  - Ground support and on-orbit operations

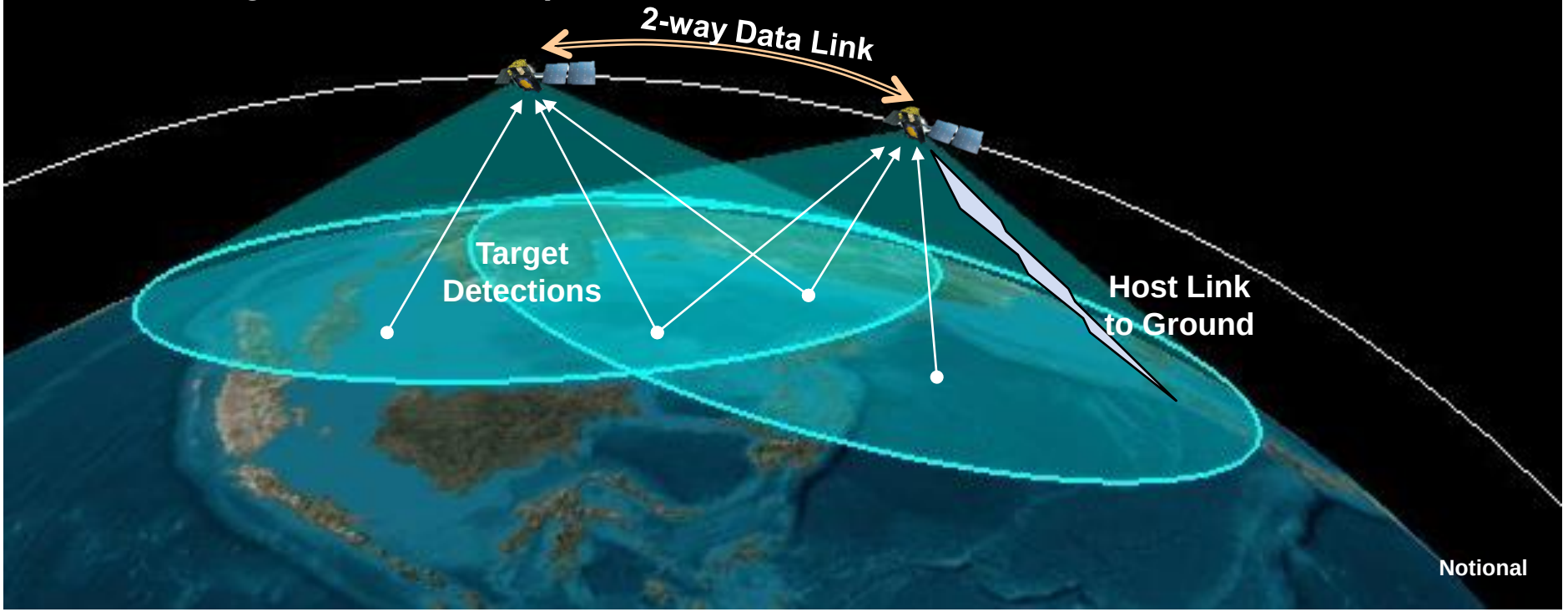
Networked Nanosats



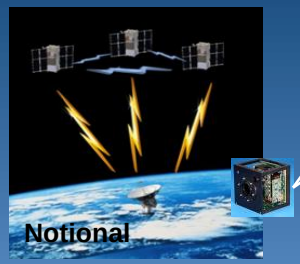
- **NTI Experiment 1 Part B: Enhanced Test Platform Capability**
  - High Assurance encrypted communication & Rad Hard Processor
  - High precision Attitude and Determination Control System
  - Compliant with MDA-STD-008 (KV Modular Open Architecture)
  - 3U form-factor CubeSats
  - Payload launch in 2019
  - OSD SBIR Funds (2yr PoP)

Overhead Miniature Sensor Experiment for HGV Tracking (OMniSciEnT)

- Demonstrate small satellite missile defense sensor capability
  - Two satellites representing a potential constellation in low earth orbit
  - Overlapping rings with wide-field of view sensor providing persistent stereo coverage
  - Low latency satellite-to-satellite and satellite-to-ground communications
  - Detection and continuous fire control quality tracks in real-time
  - 50 kg class to reduce production and launch costs

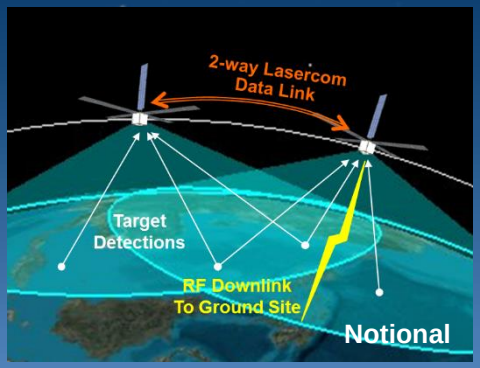


Technology Demonstration Roadmap



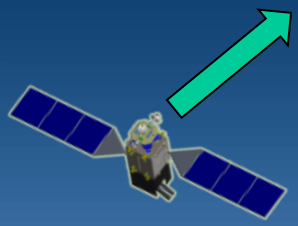
CubeSat Network Communication
Launches 2018

CubeSat Laser Communications
Launches 2019



OMniSciEnt
Launches 2020

BMDS Space Layer



Discriminating Sensor Space Demonstration
Launches 2023

WLIF (FE-01)
Fall 2017

Airborne Advanced Sensor
First Flight 2019

2017 | 2018 | 2019 | 2020 | 2021 | 2022+

Technology Interest Areas

- **Interceptor Technology**
  - Guidance, navigation, & control
  - Batteries & power systems
  - Advanced materials
    - High temperature
    - Light weight
  - Seeker technology
  - Rad-Hard technology
  - Deployment systems
  - Lightweight composites
  - Propulsion & control technologies
    - Improved specific impulse

- **C2BMC**
  - Advanced tracking & discrimination algorithms
  - Command & control algorithms
  - Low latency and secure communications
  - Battlespace management
  - Data fusion
  - Warfighter training

- **Modeling & Simulation**
  - Lethality
  - Battlespace environments
  - Engagement
  - Aerothermal environments
  - Technology investment evaluation
  - Test verification

- **BMDS Testing**
  - Affordable targets
  - Scene generation
  - Hardware in the loop
  - Rapid analysis software toolkits
  - Predictive analysis & modeling
  - Range safety

- **Sensors**
  - Electro-optic/infrared and radar
    - Transmit/receive modules
    - Focal plane arrays
  - Signal & data processing algorithms
  - Rad-hard technology
  - Telescopes & antennas
  - Windows & radomes

Enabling the Future

- **Invest in Technology to revolutionize the BMDS**
  - Improve discrimination by enabling persistent EO/IR sensors
  - Transform missile defense by introducing directed energy
  - Deploy multiple kill vehicles on each interceptor
- **Prove technology readiness through competitive prototyping**
- **Expand our efforts to integrate "Left, and Right, of Launch"**