Hypersonic Defense Overview

- 2020 MDA Small Business Conference -

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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**

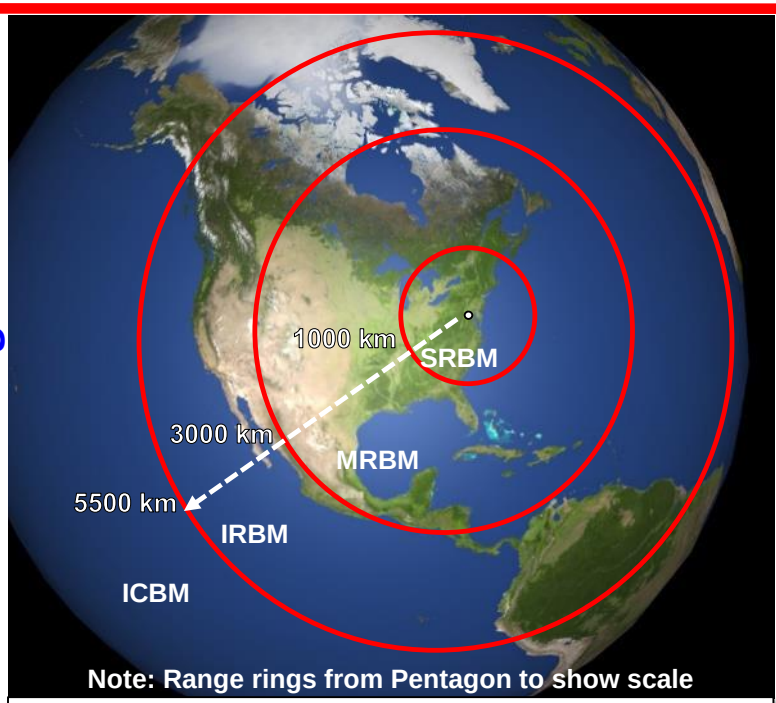
North Korea
Hwasong-15 ICBM

Iran
Emad-1 MRBM with MaRV

China
Dong Feng (DF-26) IRBM

Russia
Concept Hypersonic Glide Vehicle

Range



Note: Range rings from Pentagon to show scale

SRBM:	Short Range Ballistic Missile	(300-1000 km :: 621 mi)
MRBM:	Medium Range Ballistic Missile	(1000-3000 km :: 1864 mi)
IRBM:	Intermediate Range Ballistic Missile	(3000-5500 km :: 3418 mi)
ICBM:	Intercontinental Ballistic Missile	(5500+ km :: 3418+ mi)

Speed

Subsonic:	< Mach 1	(< 770 mph)
Supersonic:	Mach 1-5	(770-3,800 mph)
Hypersonic:	Mach 5-10	(3,800-7,700 mph)
High Hypersonic:	Mach 10-25	(7,700-19,200 mph)

Ref: 2019 Missile Defense Review

Missile Defense Agency Mission

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









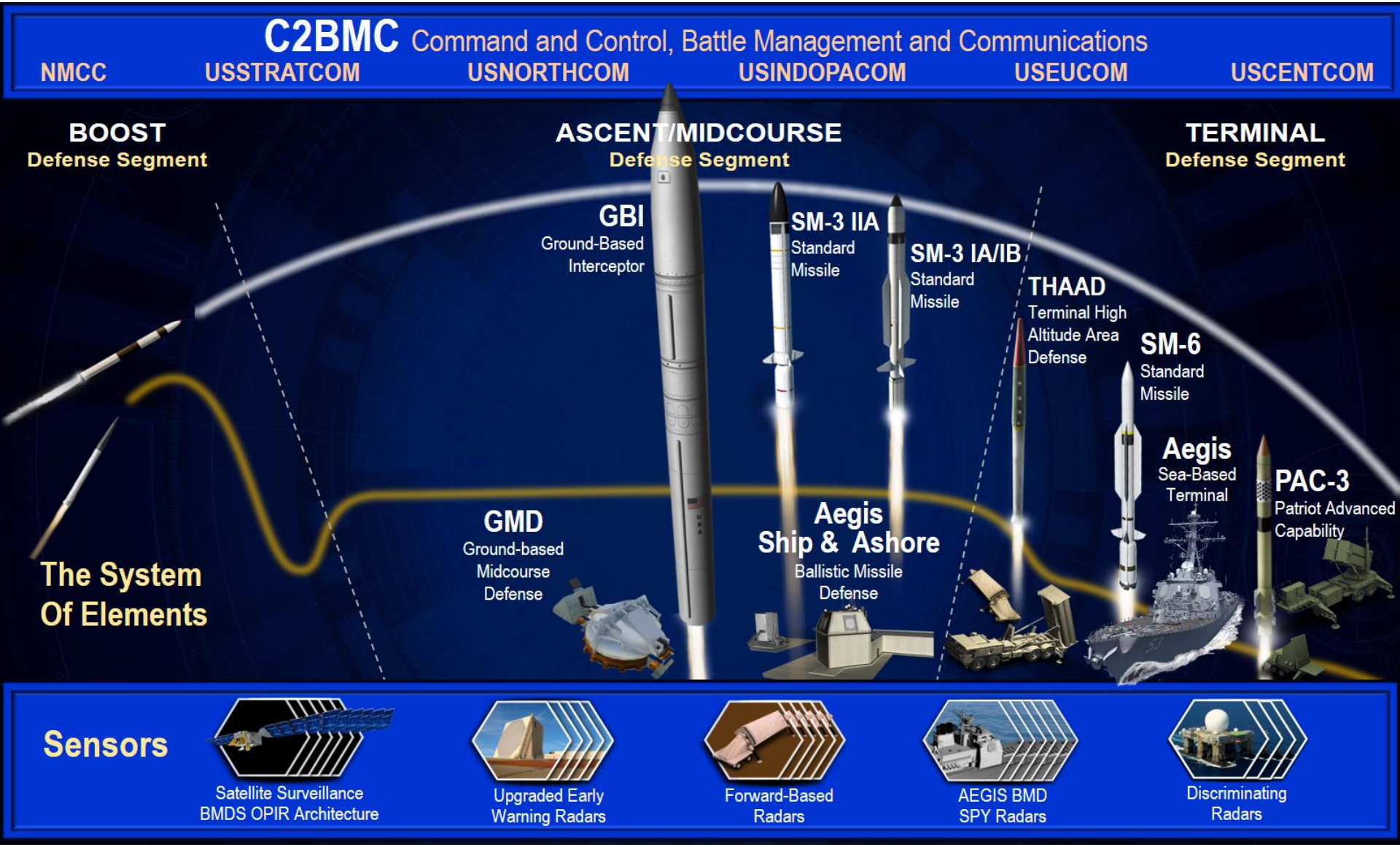
Missile Defense Capability Globally Deployed

Missile Defense Agency Lines of Effort
- In Support of the National Defense Strategy -

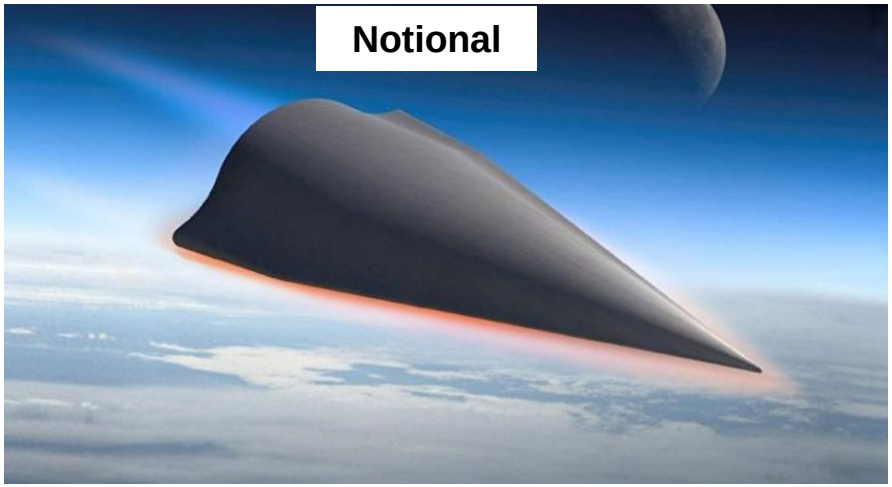
- **Build Warfighter confidence through focus on readiness and sustainment**
- **Increase engagement capability and capacity to outpace emerging threats**
- **Increase speed of delivery of new capability to address the evolving threat**

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



Hypersonic Defense



- **Although proposed since WWII, technological advances are now making hypersonic weapons practicable for our adversaries**
  - **High Speed (> Mach 5)**
  - **Highly Maneuverable in low altitudes**
- **MDA understands the emerging threat posed by hypersonic weapons**
  - **Blurs traditional lines between ballistic missile defense (BMD) and air/cruise missile defense (A/CMD)**
  - **Low flight altitude versus radar detection range**
  - **High speed shortens timeline**
- **Rapid pace of our adversary's development requires our own rapid pace of defensive system development**
  - **Innovative acquisition and system development strategies from both government and our industry partners**

Hypersonic Defense Activities

- **Authorities: National Defense Authorization Act for Fiscal Year 2017 designates the MDA Director as Executive Agent for the DoD for the development of our hypersonic defense architecture**
- **MDA Priority: Rapidly address the emerging threats**

  Working with COCOMs, Services, Agencies, Labs and Industry to:

  - **Continuously refine threat models, understand the threat**
  - **Enhance Existing Sensors, Weapons, Command and Control Capability**
  - **Define, select, and quickly develop and demonstrate integrated defensive architecture solutions as rapid evolutions to our existing architecture**
  - **Invest in sensor, weapon, command and control technologies for future architecture evolutions**

The Time for Delays and Studies and Objections Is Over...The Threat Has Voted and Continues to Visibly Vote

Hypersonic Defense Program Overview

Hypersonic Threat

Hypersonic Defense (HD) Program Content

Regional Glide Phase Defeat Capability

Develop and test a prototype Regional Glide Phase Weapon System (RGPWS)

Upgrade Aegis BMD combat system capabilities for RGPWS

Engineering Enablers

Perform complex engineering effort to: define the architecture design and conduct analysis, provide threat model updates, provide HD roadmap, conduct lethality testing and M&S, and design and conduct ground testing of interceptor concepts

Leverage and Upgrade Existing Systems

Upgrade existing missile defense architecture capabilities to address hypersonic threats

Partner Flight Test Participation

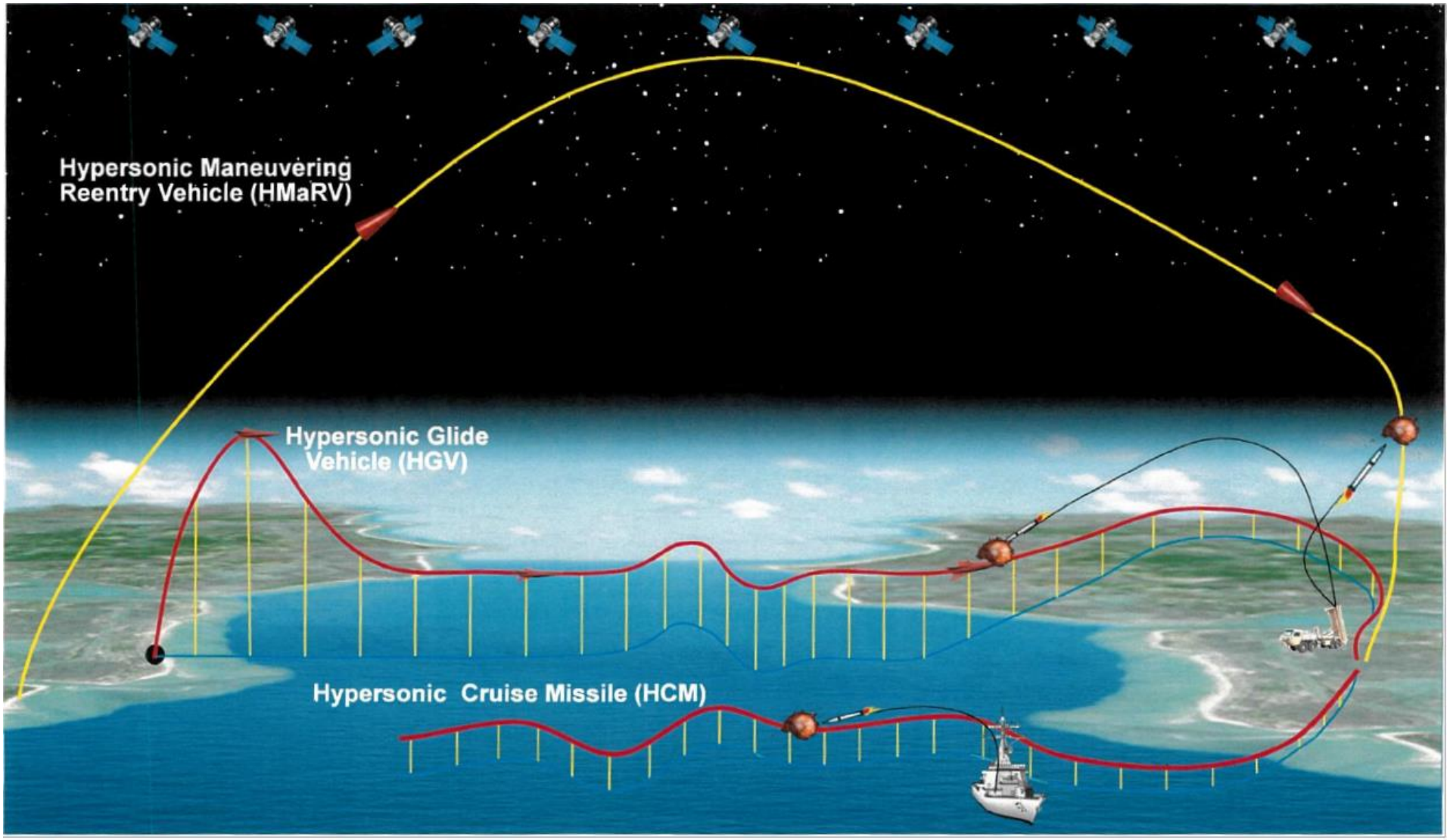
Participate in partner flight test opportunities

Disruptive Technologies for Future HD Architectures

Identify and develop new technologies to support future hypersonic defense architectures

Hypersonic Defense Program enables future delivery of a Layered Defense Architecture

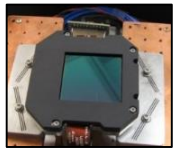
Hypersonic Defense Architecture Concept



Example Technology Development for Hypersonic Defense

Sensors and Fire Control





- Forward-based sensor architecture
  - Airborne or space-based Infrared (IR)
  - Comms latency mitigation
- Wide Field-of-View (FOV) digital focal plane arrays
- High data rate, low latency processing and communications for Command and Control, Battle Management, and Communications (C2BMC)
- Adaptive guidance algorithms
- Predicted intercept point
  - Energy management
- Netted Sensor and Fire Control technology

Booster and Airframe


Notional

- Faster airframe response
- High axial-g boosters
- High-g structural tolerance
- Thrust vector control
  - Long burn durations
  - Terminal guidance
- Variable thrust boosters
  - Multiple pulse burns
  - Relightable and throttleable solid rocket propulsion
  - Air-breathing propulsion
- High temperature materials
- Interceptor with high lift-to-drag
  - Hypersonic glide
  - Hypersonic cruise missile

Seekers


- Advanced IR seeker design
  - Long operating time and acquisition range
  - Window cooling and materials
  - Packaging
  - Strapped down, non-gimballed
  - Large FOV
  - Waveband optimization
  - Increased dynamic range

Hypersonic Defense Program Summary

- **Hypersonic Defense is highly complex and challenging, analogous to the challenge undertaken by Ballistic Missile Defense in the 1980's and 1990's**
- **The MDA Hypersonic Defense Program initial funding supports**
  - **Modification of existing defense elements for situational awareness of hypersonic threats**
  - **Design, analysis, M&S, and testing of high risk interceptor components and capabilities**
  - **Architecture design, systems engineering, Analysis of Alternatives for Defense Against Hypersonic Threats**
  - **Participation in Partner Flight Testing**
  - **Development and flight testing a prototype Regional Glide Phase Weapon System**
- **Hypersonic Defense Requires Advanced Capability Development to Outpace the Evolving Hypersonic Threats**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