



18TH

# AUSA MISSILE SYMPOSIUM-2017

## Panel 1

Requirements generation and management supporting innovation and rapid capability.

### Members

COL Dusty O'Neill

COL Jim Payne

COL Matt Tedesco

### Moderator

COL (R) Harry Cohen

# **SETTING THE STAGE**



## **Characterization of the Capability Development Environment:**

- Cumbersome and bureaucratic requirements development and validation process (JCIDS)
- Operational testing and evaluation process with standards that serve as obstacles to fielding rather than an instrument to identify and correct critical deficiencies
- Cooperation between Industry rivals is the exception rather than the rule
- Result: Prolonged Capability development timelines that often render original requirements OBE; Seemingly more cancelled programs than successful fieldings

## **Proposed Changes to JCIDS:**

- Attempts to streamline the process – Fewer Joint Staff “touch points”
- CDD – may include a section to propose/follow a rapid fielding approach and allow appendices for incremental capabilities

## **“Best Practices” Worth Exploring:**

- Dynamics of Rapid Equipping Force (REF)
- Incremental development and fielding



# 18TH AUSA MISSILE SYMPOSIUM-2017

## Panel 2

**Identifying, developing, and evaluating key technology for rapid transfer and integration.**

### Members

Dr. Juanita Harris, (SES)  
Mr. Chuck Hoppe  
Mr. William B. Nelson  
Dr. Richard Swatloski  
Dr. Anthony (Tony) Skjellum  
Mr. Dave Arterburn

### Moderator

Mr. Eric Edwards (SES, Retired)



*Presented to:*  
**2017 AUSA MISSILE  
SYMPOSIUM**

**SUCCESSFUL METHODOLOGIES  
FOR TRANSITIONING MISSILE S&T**



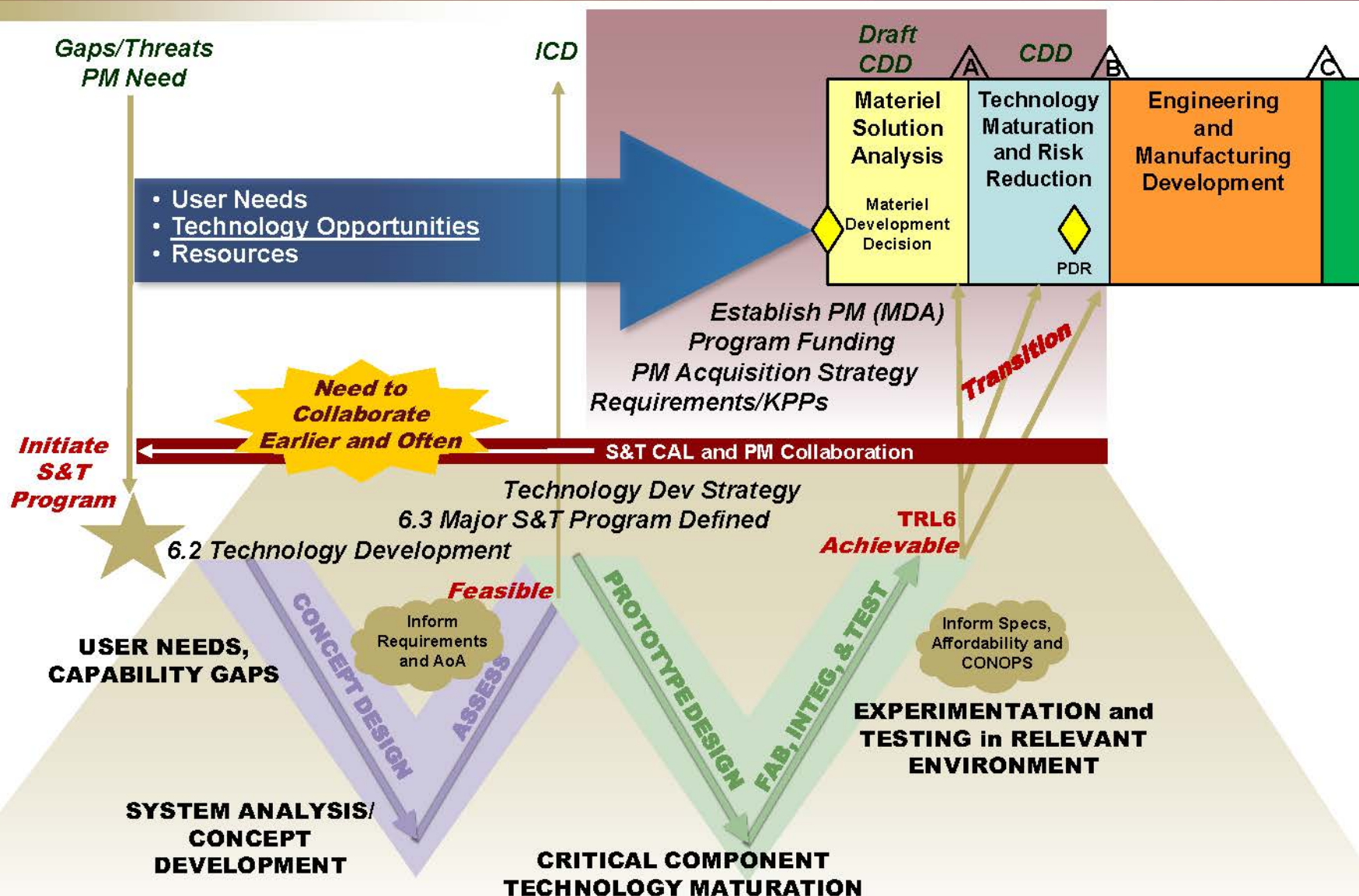
**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

**11 APRIL 2017**

*Presented by:*  
**DR. JUANITA HARRIS, SES**  
**DIRECTOR**  
WEAPONS DEVELOPMENT & INTEGRATION DIRECTORATE  
AVIATION & MISSILE RESEARCH, DEVELOPMENT &  
ENGINEERING CENTER



# AMRDEC S&T Initiation and Transition to PEOs



# Missile S&T Capability Areas

## AIR DEFENSE

Defend the force and selected geopolitical assets from aerial attack, missile attack and surveillance

- Point Defense
- Area Defense
- Platform Defense

## FIRE SUPPORT

Destroy, neutralize, or suppress the enemy by cannon, rocket, and missile fire and to help integrate fire support assets into combined arms operations

## PROGRAM ANALYSIS & EVALUATION

Proponent for 6.2 programs that are deemed too immature to transition to one of the four capability areas, are pervasive across two or more of the capability areas, or are core competencies



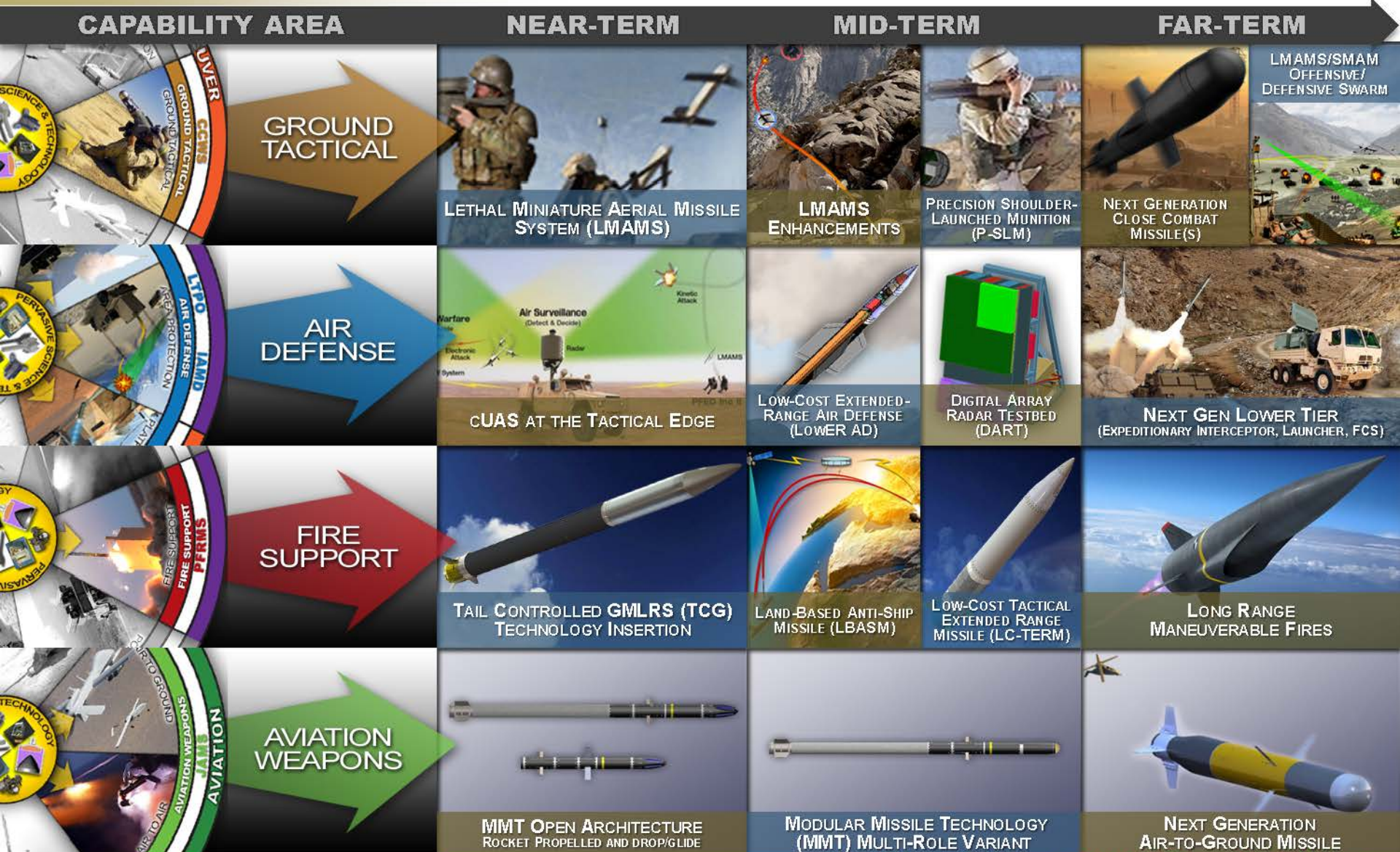
## GROUND TACTICAL (CLOSE COMBAT)

Direct fire and precision weapons, supported by indirect fire, air-delivered fires, and nonlethal engagement means to decide the outcome of battles and engagements

## AVIATION MISSILES

Find, fix, and destroy the enemy through fire and maneuver; and to provide combat, combat service and combat service support in coordinated operations as an integral member of the combined arms team







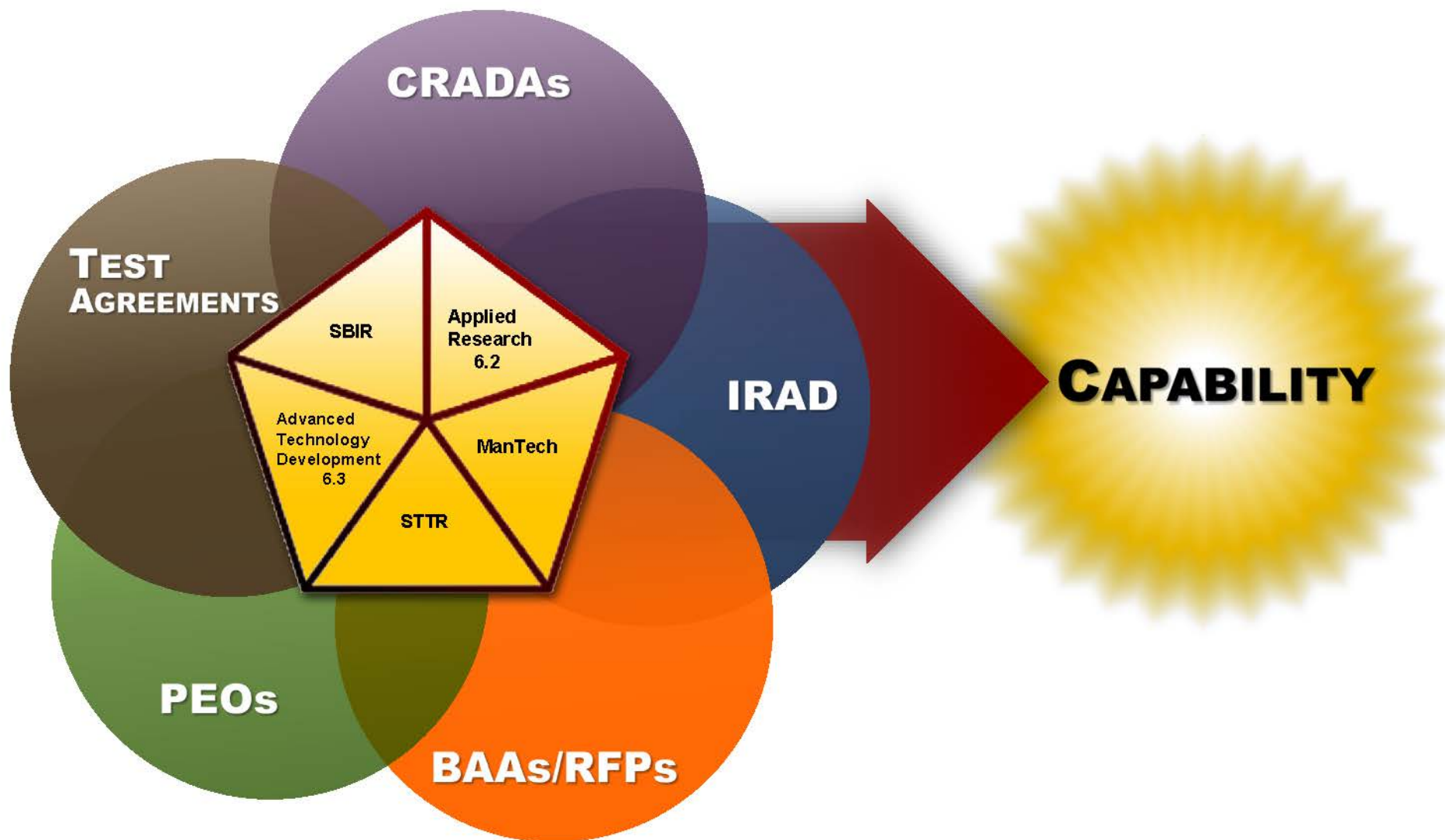


- **Unified Action Enterprise (AMCOM, AMRDEC, ACC-R)**
- **Internal AMRDEC Enterprise**
- **PEOs, COEs, Other RDECs, and OGAs**
- **Industry & Academia**
  - Industry Days
  - Technology Forums
  - Technical Networking
- **International Ventures**
  - DEAs, PAs





# Missile S&T Collaborative Incubation of Ideas



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**



U.S. ARMY  
**RDECOM**



# Back-Up Charts

<b>S&amp;T Activities</b>	<b>Basic Research (6.1)</b>	Systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and/or observable facts without specific applications toward processes or products in mind.
	<b>Applied Research (6.2)</b>	Systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met.
	<b>Advanced Technology Development (6.3)</b>	Includes all efforts that have moved into the development and integration of hardware for field experiments and tests.

6.4 – Demonstration and Validation  
6.6 – RDT&E Mgmt Support

6.5 – Eng Manufacturing and Development  
6.7 – Operational System Development





# ***COMMUNICATIONS-ELECTRONICS RESEARCH, DEVELOPMENT & ENGINEERING CENTER (CERDEC)***

**MR. WILLIAM C. "CHUCK" HOPPE, DB-V**

ASSOCIATE DIRECTOR, SCIENCE, TECHNOLOGY, & ENGINEERING  
*COMMUNICATIONS-ELECTRONICS RESEARCH, DEVELOPMENT  
& ENGINEERING CENTER (CERDEC)*

11 APRIL 2017





U.S. ARMY  
**RDECOM**

APPROVED FOR PUBLIC RELEASE

# CERDEC MISSION WITHIN RDECOM

**CERDEC**  
U.S. ARMY - RDECOM



ENSURING THE DECISIVE EDGE FOR THE JOINT WARFIGHTER AND NATION

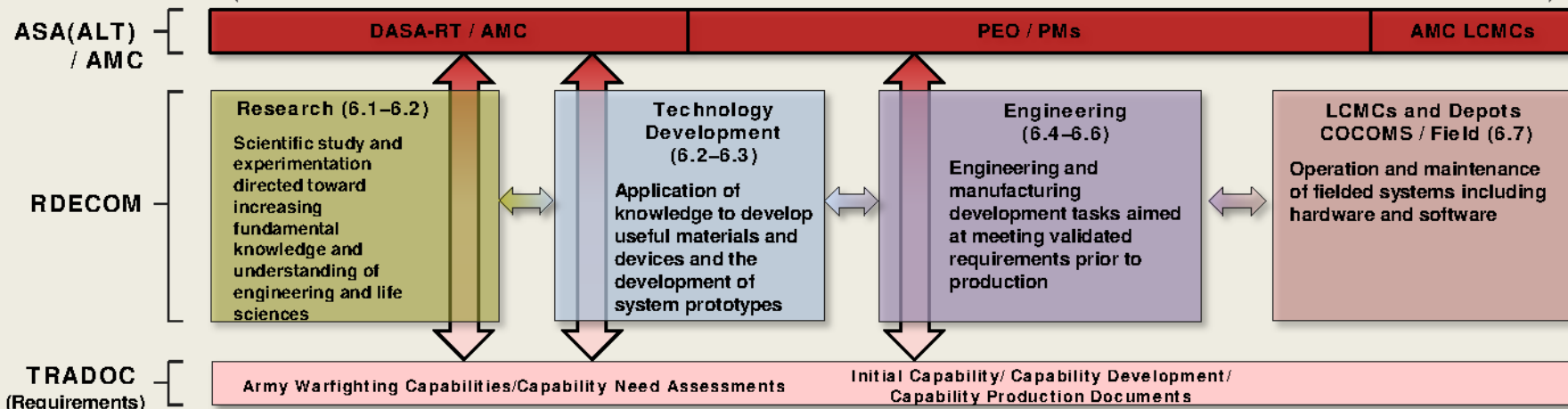
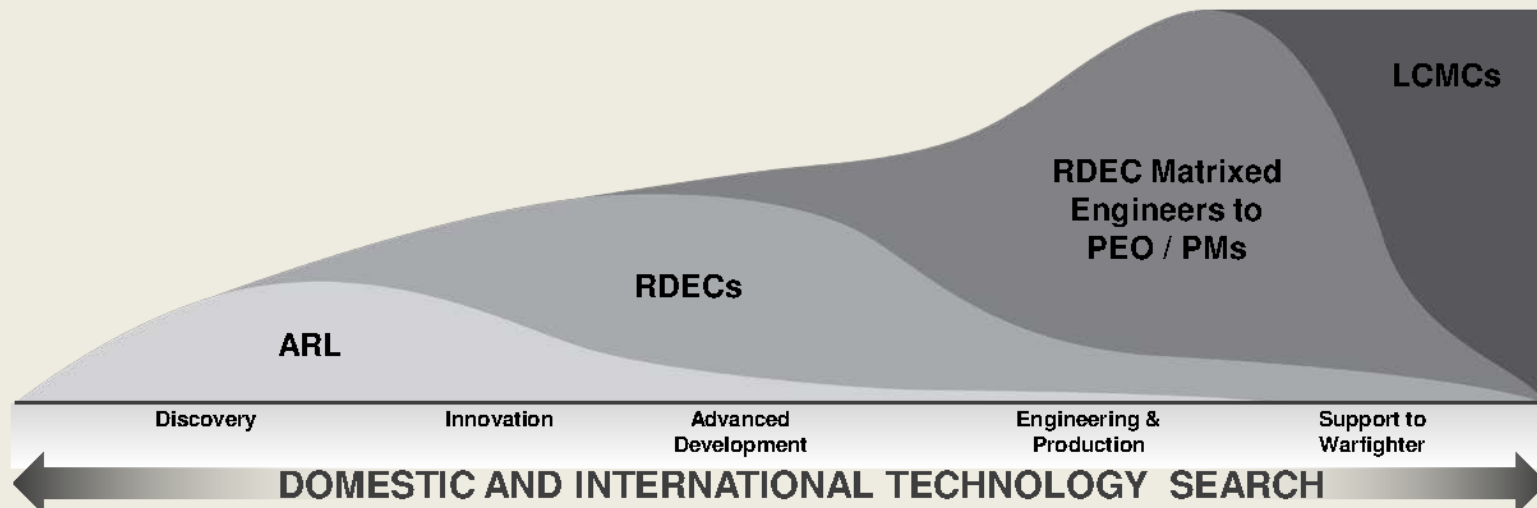


U.S. ARMY  
**RDECOM**

# RDECOM BUSINESS MODEL

**CERDEC**  
US ARMY - RDECOM

## ACQUISITION & ENGINEERING LIFE CYCLE





## Private Sector

**40-Total CRADA's\*** for SIGINT, Cloud Computing, EW, ISR, ISR/EW/Cyber, Data Analytics, SIGINT and testing. Also STEM partnerships with many Universities in the areas of Systems Engineering and Computer and Electrical Engineering

## International

Current Agreements are held with: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Israel, Italy, Japan, Netherlands, Norway, Poland, Singapore, South Korea, Spain, Sweden, and the United Kingdom



## Acquisition & User Community

Systems Engineering, EW, ISR,  
Sensors, Offensive Cyber  
Operations, Architecture,  
Operational Energy and  
Requirements Development

### *Non-Army*

Cyber Operations, Technical Forensics, EW/CIED, Power & Energy Technologies and Sensors

## ENHANCED MUTUAL RELIANCE

\*40 Cooperative Research and Development Agreements (CRADAs) a/o 6 April 2017;  
Four (4) additional being worked.

U.S. ARMY  
**RDECOM**

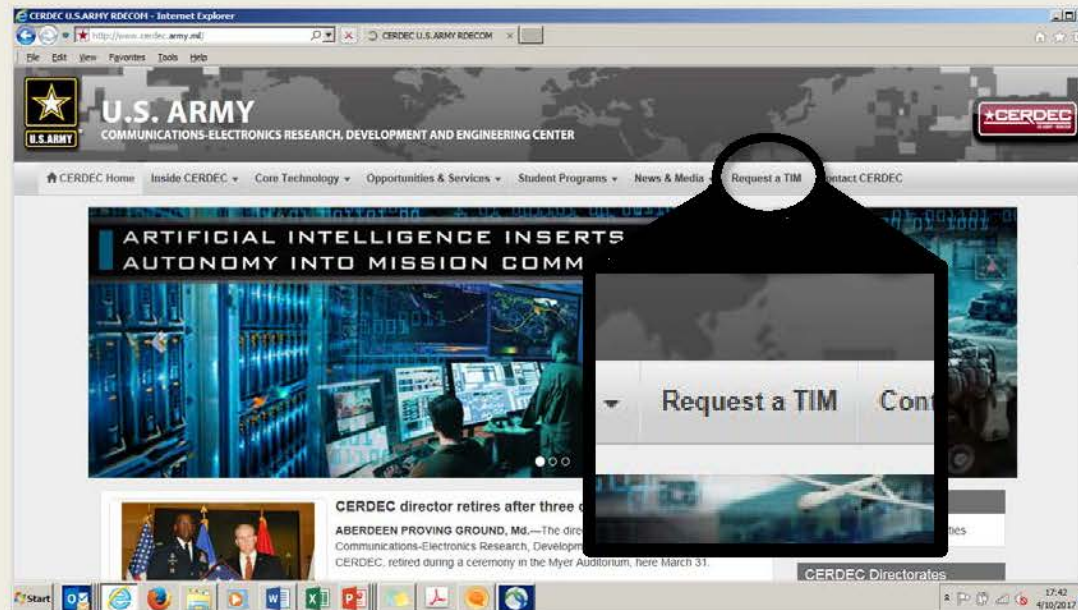
LET'S TALK

★**CERDEC**  
US ARMY - RDECOM

Request a Technical Interchange Meeting:

**[www.cerdec.army.mil](http://www.cerdec.army.mil)**

Click "Request TIM" in banner.







# US Army Space and Missile Defense Command Army Forces Strategic Command

**WILLIAM NELSON**  
**Acting Director, Programs and Technologies**



Transition To  
Program of Record

24

22

50 kW-class  
System Demonstration

18

Integrated 100 kW-  
class System Demo

Beam Control  
System and Laser  
Demo

14

10 kW COTS  
Laser Demo

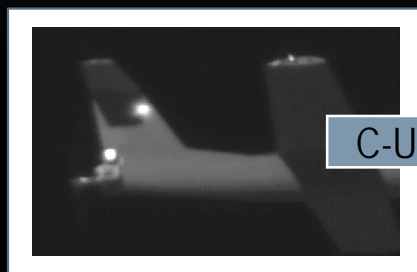
12



ARMY PATH TO HIGH ENERGY LASER SYSTEM



C-RAM



C-UAS

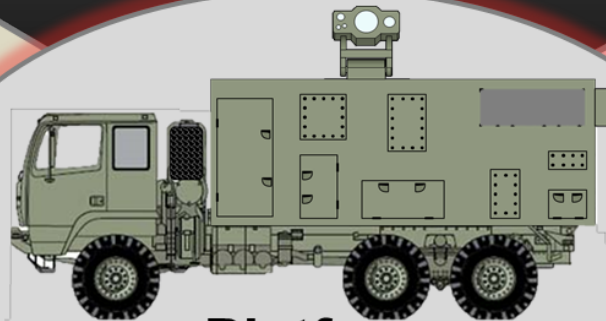


DEMOS AND DATA COLLECTIONS

## Laser

- Compact, efficient laser

- $\geq 115$  kW
- Power in the Bucket Efficiency  $\geq 24\%$



## Platform Integration

## Beam Control

- Develop beam director assembly with required jitter, slew rate, acceleration and jerk
- Tracking and targeting under adverse conditions:
  - Advanced adaptive optics
  - Illuminator lasers
  - Enhanced tracking sensor

## Command and Control

- Single operator using warfighter-machine interface
- Integrated Air and Missile Defense Architecture compliant
- Joint Laser Deconfliction System

## Thermal Management

- Supports deep magazine
- Non-traditional laser cooling system
- Precise cooling for laser modules

*Blue text denotes an S&T development effort*

## Power

- Batteries provide stable power
- Onboard generator(s)

# High Energy Laser Subsystems





- Three Small Satellites Launched Oct 15
  - SNAP– Communications
- Additional Launch in 2017
  - Kestrel Eye - Imagery



# SPACE RESEARCH & DEVELOPMENT

## Hypersonic Glide Body



- High-Power Microwave for Counter-IED and other applications
- Microwave Frequency Oscillator
  - Successfully tested at China Lake
  - Size and weight reduction
  - Future demos planned

- Supporting Defense-Wide Conventional Prompt Strike Technology Development Project
- Successful Demonstration of Hypersonic Boost Glide Flight
- SMDC Test Team Planning and Executing Upcoming Navy Flight Experiment



# OTHER PROMISING TECHNOLOGY





- Compact efficient lasers with excellent beam quality
- Advanced Adaptive Optics to compensate for atmospheric effects
- Enhance tracking sensors for target acquisition and track
- Compact non-traditional laser cooling
- Low SWaP, high capacity electronics / processors for CubeSat / MicroSat application
  - Available orbit-average power for operation of the sensor / payload
- High Bandwidth data collection and dissemination
  - Data Compression
  - Laser Communications (sat-sat, sat-gnd)
- Small imaging / situational awareness sensors for MicroSats
  - MSI, HSI, SAR, Lidar, etc.

## Top Technology Needs – HEL and Space

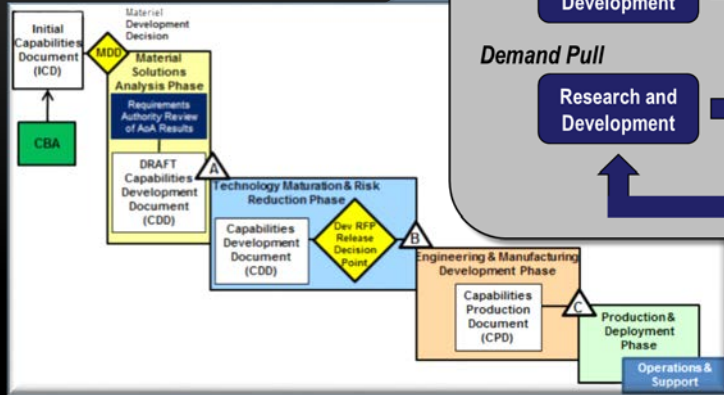


- High Capacity Storable Batteries
- Advanced Thermal Protection Materials
- Autonomous Flight Safety Systems
- Space and High Altitude Data Collection

# Technology Needs – Hypersonics and HPM



## Requirements Driven



### Technology Push

Research and Development → Project Ideas → Funding → Need? Avoid Gap?

### Demand Pull

Research and Development → Project Ideas → Funding → Known Need or Gap

## Idea Driven



Requirements,  
User, and  
Acquisition  
Communities

"Market"  
Analysis  
User Needs and  
Wants

## Balanced & Integrated Approach

User Need  
Oriented  
Solutions



Technology  
Oriented  
Solutions

Integration

New  
Technologies &  
New  
Capabilities

Demand Sphere

Rapid Transfer & Integration

Potential Sphere

# Integrating Technology Approaches



THANK YOU



# The Office for Technology

An Overview of Our Process

Richard P. Swatloski, Ph.D., CLP

THE UNIVERSITY OF  
**ALABAMA**

*Office of the Vice President for*  
**Research & Economic Development**  
*Office for Technology Transfer*



# What We Do



Protect IP

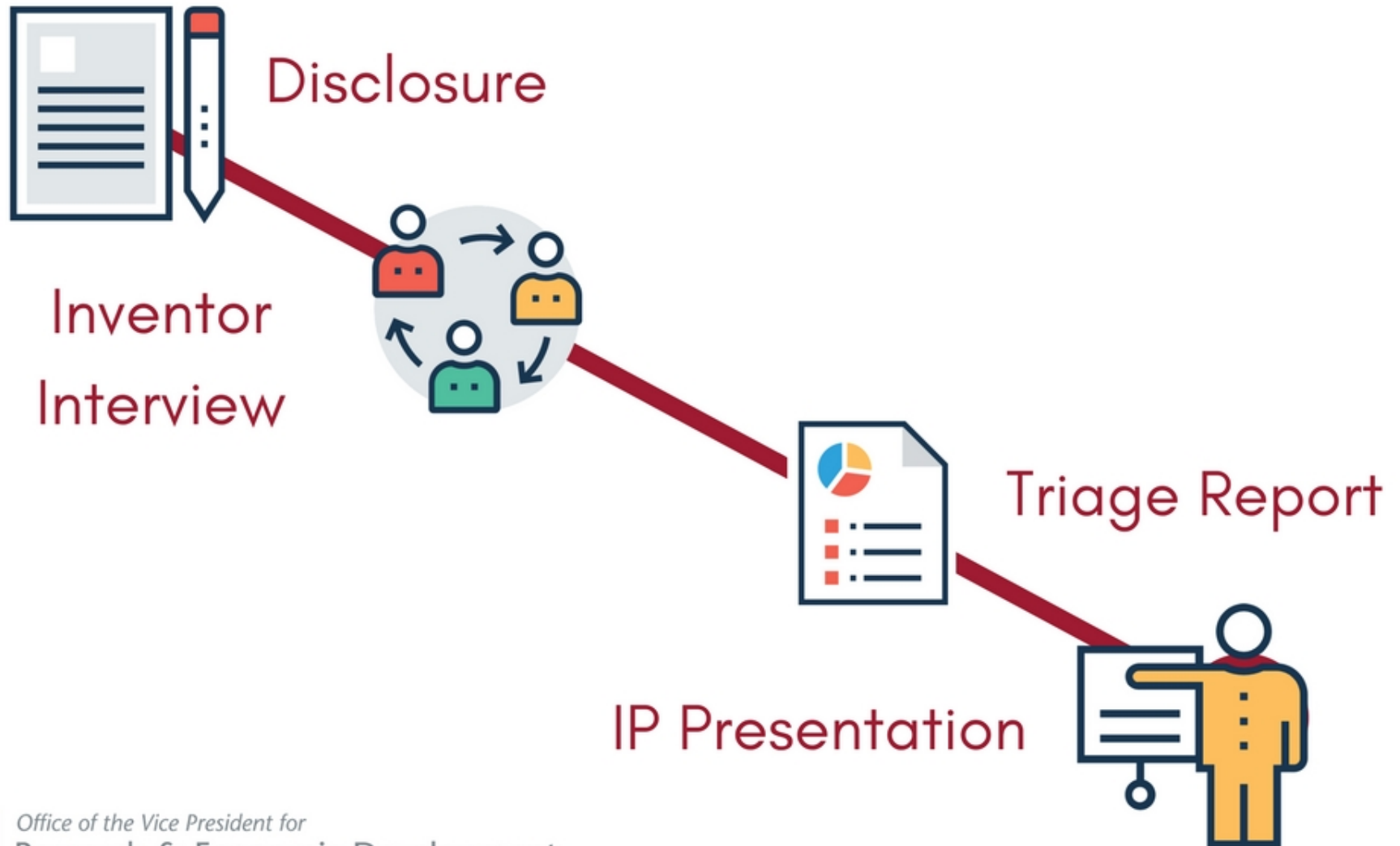


Commercialization



Educate

# Our Process





# The Disclosure



- **Standardized Form**
- **Provides details**
- **Helps to understand concept**



# Inventor Interview



- **Discussion with inventor**
- **Often face to face**
- **Allows for open dialogue**



# Triage Report



- **Provides high-level info**
- **Market potential and info**
- **Prior art search: patent & literature**





# IP Presentation



- **"Shark Tank" style pitch**
- **Cross-discipline committee**
- **Inventors pitch to have invention protected**



# After the Presentation



Create Marketing  
Material



Contact Industry  
Members



Pursue License  
Deals



Office of the Vice President for  
Research & Economic Development  
Office for Technology Transfer



**QUESTIONS?**





AUBURN UNIVERSITY

SAMUEL GINN  
COLLEGE OF ENGINEERING

# Identifying, developing, and evaluating key technology for rapid transfer and integration

Anthony Skjellum, Director  
[skjellum@auburn.edu](mailto:skjellum@auburn.edu)

<http://mccrary.auburn.edu>

April 11, 2017  
AUSA MSS

Unclassified Briefing – No Restrictions on Reproduction or Dissemination

THIS IS ENGINEERING. THIS IS AUBURN.

# Overview

- Blockchains
- IoT
- SecDevOps
- Machine Learning



THIS IS ENGINEERING. THIS IS AUBURN.

# Blockchains

- Cryptographically linked ledgers
- Bitcoin is best known example
- Some uses
  - Cryptocurrency
  - Provenance of data
  - Contracts
  - Recording information indelibly
  - Building short-term communication collaboratives



# IoT

- A small computer, a sensor, an actuator and a network port
- Will be ultimately COTS way to get embedded devices for applications in tactical systems and in making environments smart
- Replacement without repair
- The “aggregate” work as an API, don’t think like individual computers
- Need to be secured

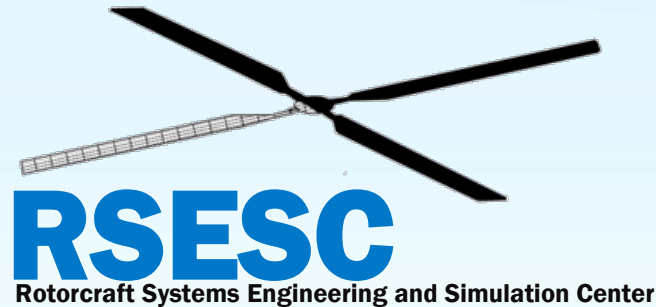
# SecDevOps

- DevOps – Rapid collaboration between developers and deployment of code; agile
- Security has been an afterthought
- Lots of COTS and COTS+ software is developed agilely now
- SecDevOps – emerging as a strategy to introduce security themes into the DevOps world
- Early Days
- Worth exploring

# Machine Learning

- Take data and find correlations
- Give your analysts opportunities to make causations
- Can drive the Baconian scientific method
- Provide ways to find needles in haystacks
- Requires experts in building the neural networks
- Many packages exist and are developing
- Opportunity to use desktop to big clusters of computers depending on “how big data area”





Identifying and Evaluating Key Technology For Rapid  
Transfer using Model Based System Engineering  
*Presented at the*  
*2017 AUSA Missile Systems Symposium*

*David Arterburn*

*Director, RSESC*

*(256) 824-6846*

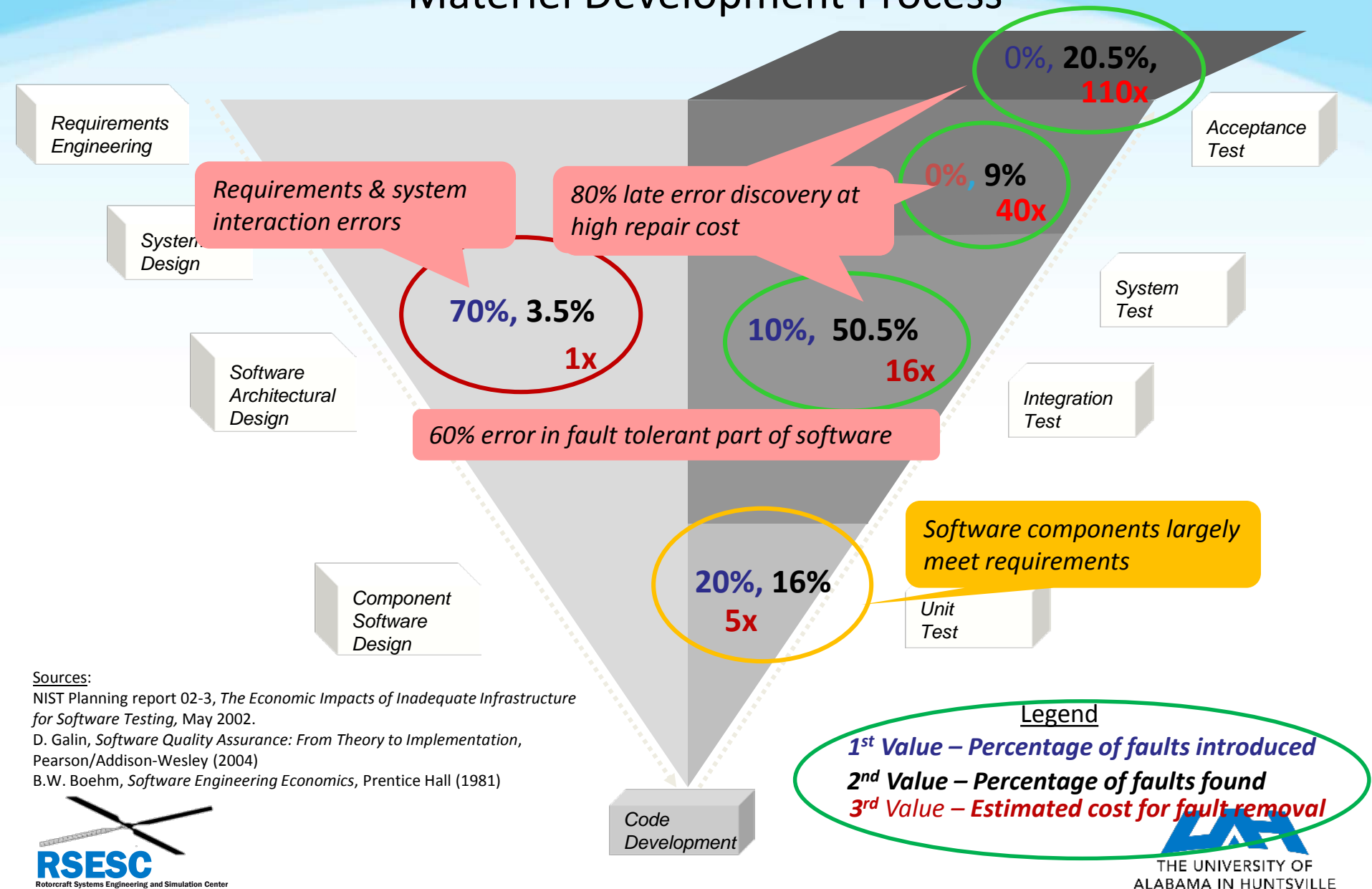
*[arterbd@uah.edu](mailto:arterbd@uah.edu)*

*<http://www.uah.edu/rsesc>*

# Complex Systems Integration Environment

- Changes in technology are occurring much faster than changes in standards and methods of compliance
- As systems become more complex, traditional systems engineering, contracting methods and airworthiness processes and standards
  - May not be sufficient to ensure safety of the platform while supporting the acquisition process throughout the lifecycle
  - Can drive weight into the design as well as cost without significantly improving the safety and mission effectiveness of systems
  - Try before you build – Virtual prototyping of technology while assessing system level performance
- The acquisition process must clearly articulate the buyers intent in terms of mission effectiveness and capability in order to
  - Create affordable systems and understand the trade space
  - Better assess cost and schedule risk starting at source selection through airworthiness determination and fielding

# Early Problem Identification in the Materiel Development Process



## Sources:

NIST Planning report 02-3, *The Economic Impacts of Inadequate Infrastructure for Software Testing*, May 2002.

D. Galin, *Software Quality Assurance: From Theory to Implementation*, Pearson/Addison-Wesley (2004)

B.W. Boehm, *Software Engineering Economics*, Prentice Hall (1981)



# RSESC Complex Systems Integration Lab (CSIL)

- The CSIL at UAH provides the necessary environment for
  - Providing the necessary synchronization required between Trade Studies (Technology Push) and Systematic Operations Analysis (Technology Pull)
  - Executing the IPPD tradeoff methodology leveraging existing tools available from S&T and other efforts
  - Integrating new tools and methods as they become available
  - Integrating a broad range of tools into a singular environment
  - Providing the necessary methodology and stakeholder environment for successful FVL AoA execution
- ISEEM faculty, GRA and student engagement has grown significantly with the initiation of MBSE coursework and projects.
- Provides a local and low-cost location for Government and industry collaboration necessary to support decision making throughout the Acquisition Process.

# Curricula Status

- Systems Engineering Modeling
  - Course offered in previous semester (Fall '16)
  - 11 students (1 senior undergraduate, 10 graduate)
- Development of Complex Systems Models
  - Course offered in current semester (Spring '17)
  - Course objective will be development & simulation of a complex system model
  - 6 students enrolled
  - Student projects with RSESC, PEO Aviation & NASA MSFC
- Planned curricula improvements
  - Revised sequence of topic coverage for next offering of SE Modeling (Fall '17)
  - Include objective of preparing students for OMG SysML certification
  - Better support for tool use (Cameo Enterprise Architecture)

# Recent Publications

- “Virtual Systems Integration using Model Based Systems Engineering”
  - Co authored by Dale Thomas & Bryan Mesmer
  - Presented in Session: IS-07/SSEE-07, Model-Based Systems Engineering: Methodologies and Tools II, September 15, 2016
- “Integrated System Modeling in SysML for Small Satellites”
  - Authored by Lloyd Walker & Dale Thomas
  - Presented in MST-17, Modeling and Simulation Integration and Architectures, January 12, 2017
- “Human Mental Models and Their Effects on Human and System Interactions within Socio-Technical Systems”
  - Co authored by Elizabeth Patterson & Dale Thomas
  - Presented at 15th CSER, March 23-25, 2017
- “Nuclear Thermal Propulsion Modeling Using Model Based Systems Engineering”
  - Co authored by Alexander Aueron & Dale Thomas
  - To be presented at JANNAF In-Space Chemical Propulsion Technical Interchange Meeting, 4-6 April 2017.





# Questions



# AUSA Missile Symposium

11 April 2017

LTG James H. Dickinson

USASMDC/ARSTRAT/JFCC-IMD

# ***Evolving Threat Trends***

**Ballistic Missiles**



**Land Attack Cruise Missiles**



**Hypersonic Glide Vehicles**



**Rocket, Artillery, Mortars (RAM)**



**Unmanned Aerial Vehicles**





# The Operational Environment

## Changes in the Character of War

**Lethal, Contested, Complex  
Terrain...Degraded Operations**



Adversaries, including super empowered individuals with access to WME, cyber, space and NBC



Contested in all domains, increased lethality, enabled by autonomy, robotics and AI ... the potential for overmatch



Operations among populations in complex terrain...including dense urban areas

**Systems Warfare, Preclusion,  
Sanctuary, Isolation and Reflexive  
Control.**



Increased speed of human interaction, events and action ...rapid proliferation of capabilities, constantly co evolving

**Potential to be Out-gunned, Out-ranged, Out-protected, Outdated, Out of Position ...Out of Balance**

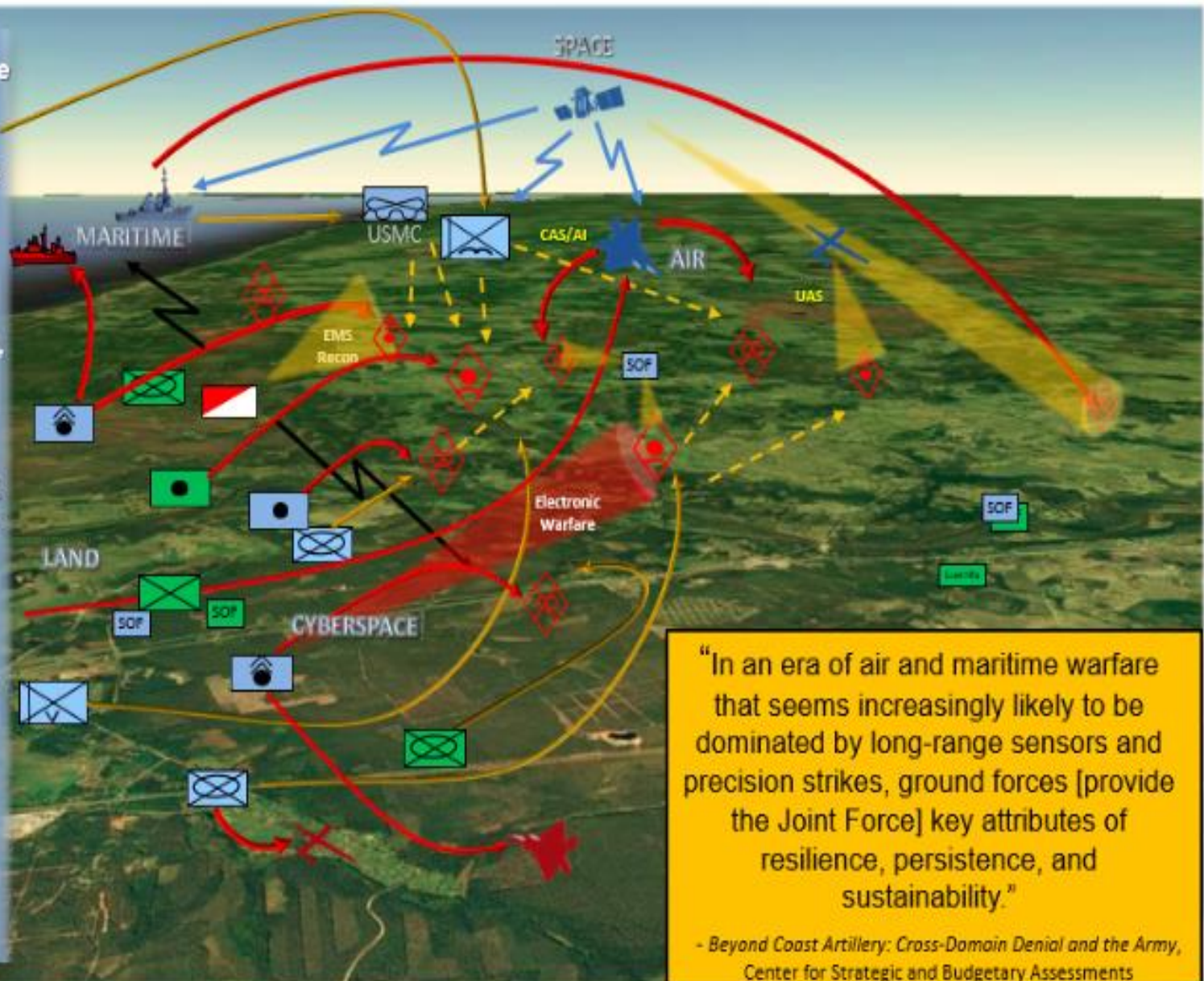
# Multi-Domain Battle:

## Achieving Cross-Domain Synergy

Maneuver to positions of relative advantage and project power across all domains to ensure freedom of action.

Integrate joint, interorganizational, and multinational capabilities to create windows of domain superiority and preserve Joint Force freedom of maneuver.

Exploit temporary domain superiority by synchronizing cross-domain fire and maneuver to achieve physical, temporal, positional, and psychological advantages.



"In an era of air and maritime warfare that seems increasingly likely to be dominated by long-range sensors and precision strikes, ground forces [provide the Joint Force] key attributes of resilience, persistence, and sustainability."

- Beyond Coast Artillery: Cross-Domain Denial and the Army, Center for Strategic and Budgetary Assessments





100th Missile Defense Brigade Crew

**High Energy Laser Mobile Test Truck (HELMTT)**







**Mobile Expeditionary High Energy  
Laser 2.0 (MEHEL) Stryker Platform**

# White Sands: Zombie Pathfinder Launch DEC 2016









# IBCS: Integrated Air and Missile Defense Battle Command System





# Terminal High Altitude Area Defense (THAAD)



## IFPC: Indirect Fire Protection Capability Increment 2







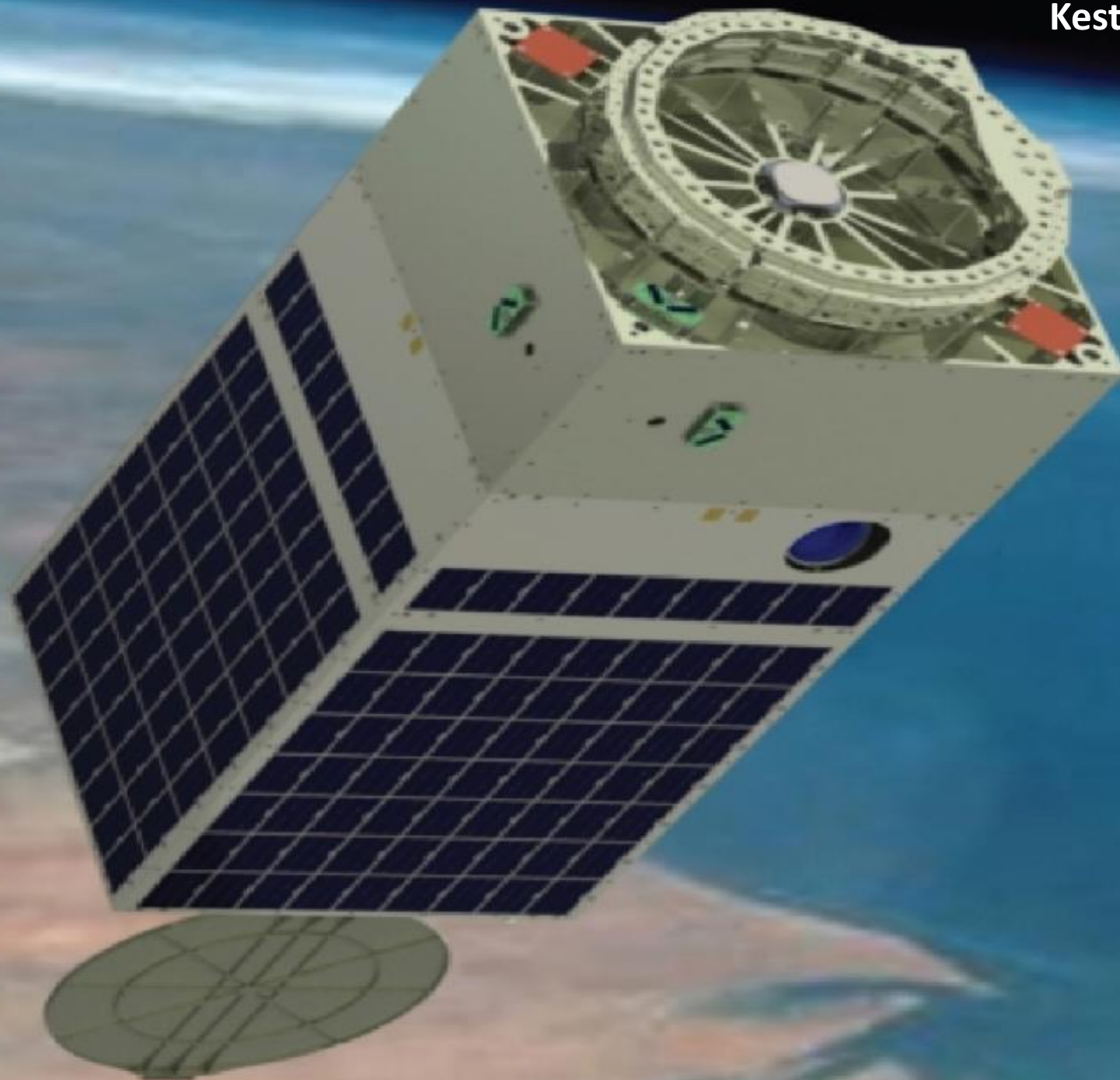
**Ft. Detrick, MD: Wideband SATCOM Operations Center**





# 1st Space Brigade: JTAGS Operators

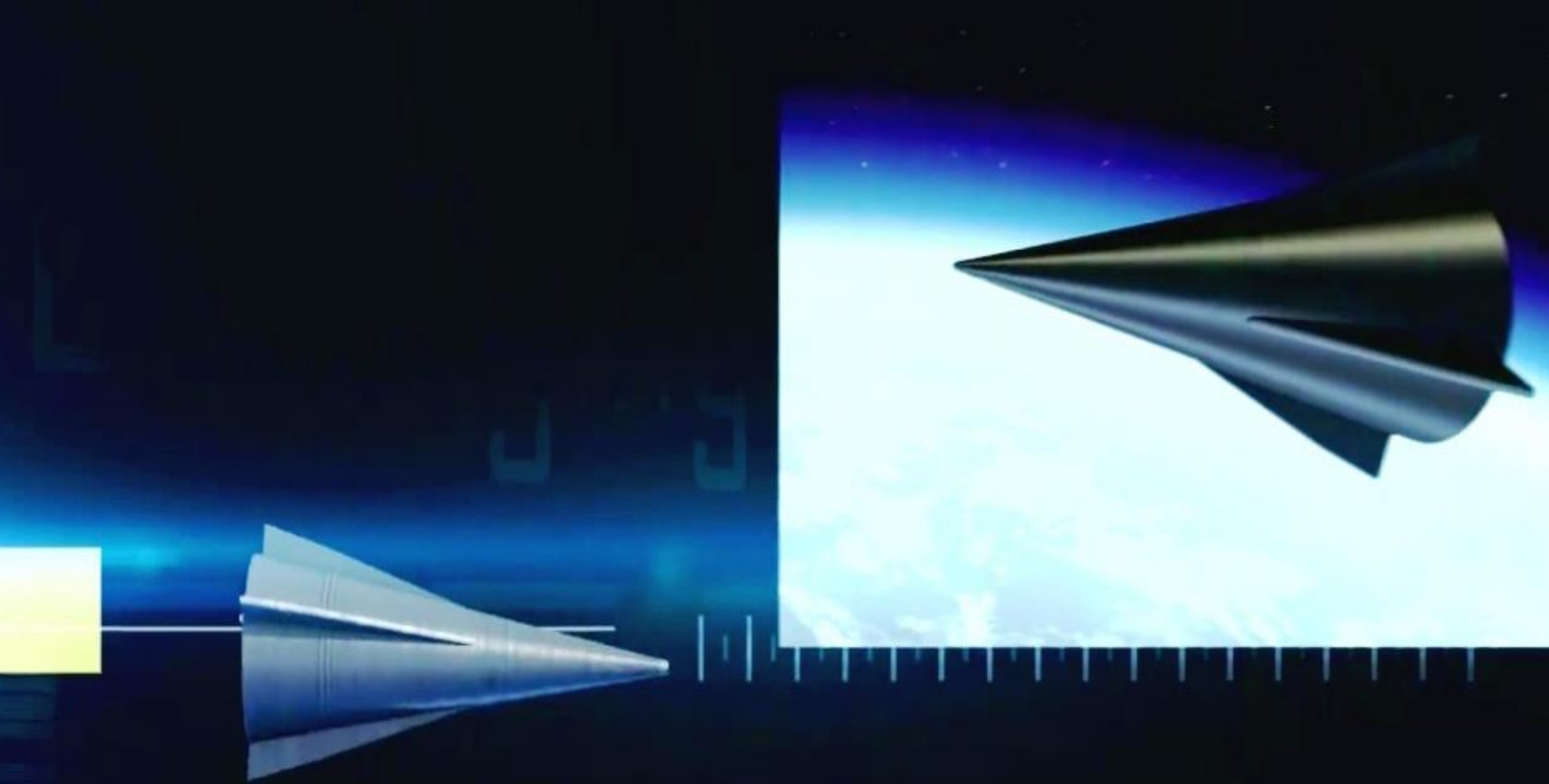






# High Altitude Technology





Advanced Hypersonic Weapon  
TECHNICAL CENTER





# AUSA Missile Symposium

11 April 2017

LTG James H. Dickinson

USASMDC/ARSTRAT/JFCC-IMD

# Ballistic Missile Defense Overview



**To: Association Of The United States Army  
Missile Defense Symposium**

**By: Mr. Tim McRae  
Deputy Program Executive for Programs and Integration  
Missile Defense Agency  
April 11, 2017**

DISTRIBUTION STATEMENT A. Approved  
for public release; distribution is unlimited.

Approved for Public Release  
17-MDA-9126 (5 April 17)





# The Increasing Ballistic Missile Threat

DISTRIBUTION STATEMENT A.  
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distribution is unlimited.  
Approved for Public Release  
17-MDA-9126 (5 April 17)



**Iranian Ashura  
2-stage solid  
MRBM launch 2012**



**North Korean Mobile ICBM  
2015**



**Iranian Emad  
MRBM 2016**



**Iranian Safir SLV on  
launch pad, 2015**



**North Korean  
Taepo Dong-2  
SLV 2016**



**Multiple Musudan  
IRBM Launches 2016**



**Inaugural Launch of an  
SLBM 2016**



**North Korean  
SLBM, 2017**



**North Korean  
SRBMs, 2017**

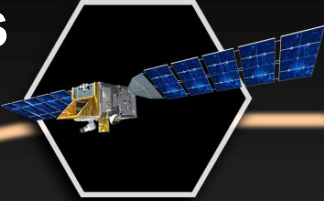




# The Ballistic Missile Defense System

## Sensors

Satellite  
Surveillance



Forward-Based  
Radar



Upgraded Early  
Warning Radar



AEGIS BMD  
SPY-I Radar



Sea-Based  
X-Band Radar



## C2BMC Command Control, Battle Management and Communications

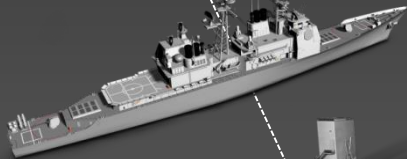
### BOOST / ASCENT Defense Segment

### MIDCOURSE Defense Segment

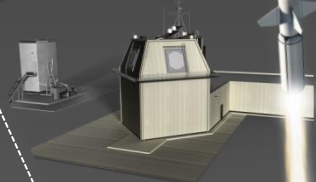
### TERMINAL Defense Segment

## The System Of Elements

Aegis  
Ballistic Missile Defense



SM-3  
Standard Missile-3



Aegis  
Ashore

GBI  
Ground-Based  
Interceptor



THAAD  
Terminal High  
Altitude Area  
Defense



Aegis  
Sea-Based Terminal



PAC-3  
Patriot Advanced  
Capability-3





# BMD Support to Combatant Commanders

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# C2BMC

## Command Control, Battle Management and Communications

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17-MDA-9126 (5 April 17)

### Current Capabilities

#### **C2BMC fielded in:**

- EUCOM
- PACOM
- CENTCOM
- STRATCOM
- NORTHCOM



**Providing Planning, Sensor Management and Engagement Support to the BMDS**

- Planning for effective BMD courses of action
- Provide Situational awareness to support C2 at all command levels
- Battle management tools to any Sensor – any Shooter
- Connectivity between BMDS and International assets and Remote sensor networks

**Plan the Fight**

**Monitor the Fight**

**Execute the Fight**

### Future Capabilities

#### **Overarching**

- **Sensor Cueing with Enhanced OPIR Data**
- **System Track and Discrimination to Support Engage on Remote**
- **Integration with the Long Range Discriminating Radar**
- **Space-based Situation Awareness**

Note: All graphics and data are Notional





# Sensors

## Detect – Track – Discriminate - Assess

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Approved for Public Release  
17-MDA-9126 (5 April 17)

### Current Capabilities

#### AN/TPY-2 Radars



##### Forward-Based Mode (FBM) Mission

- Detection close to threat origin
  - Tracks boosting ballistic missile
- Tracks, discriminates & reports

#### Sea-Based X-Band Radar (SBX)



##### Mission

- Midcourse Sensor
  - Cued search, acquisition, track, discrimination, and supports hit assessment
- Performs precision track

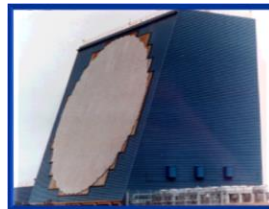
#### Upgraded Early Warning Radars (UEWR)



##### Missions

- Midcourse Sensor
  - Acquisition, tracking, and classification
- Integrated Tactical Warning & Attack Assessment (ITW/AA)
- Space Surveillance

#### COBRA DANE Radar (CD)



##### Missions

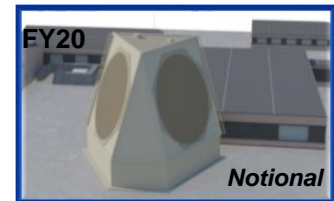
- GMD Midcourse Sensor
  - Acquisition, tracking, and classification
- Space Surveillance: Detects, identifies, & tracks man-made objects in earth orbit

### Future Capabilities

#### Upgraded Early Warning Radars (UEWR)



#### Long Range Discrimination Radar (LRDR)



##### Mission

- 24x7 persistent long range midcourse discrimination, precision tracking and hit assessment
- Raid handling performance
- Support conservation of GBI inventory
- Support multi-mission areas (e.g., SSA)

#### Overarching

- Delivery of additional assets to the BMDS (Clear, LRDR, Cape Cod) to address sensor coverage gaps
- Improve Sensor Discrimination and Debris Mitigation
- Improve Sensor Reliability



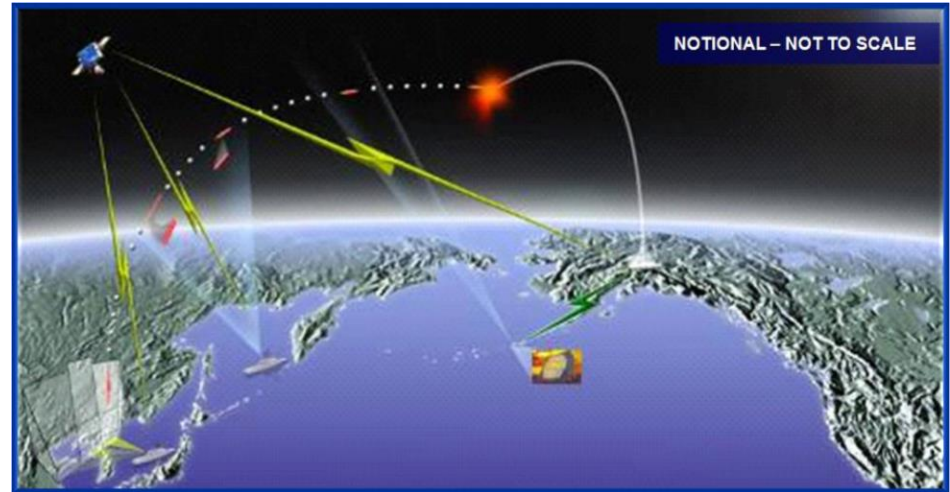
# AEGIS BMD

## Engagements Capability in All Phases of Flight: Afloat and Ashore

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17-MDA-9126 (5 April 17)

### Homeland and Regional Defense

- Long Range Surveillance & Function  
Detects and Tracks in Early Ascent Phase  
Providing Forward-Based BMDS Sensor Support



### Regional Defense

- Ascent and Midcourse  
Engagement Capability  
Defeats Short, Medium, and  
Intermediate Range Ballistic  
Missiles
- Terminal Defense Capability  
Defeats Shorter Range  
Missiles



# AEGIS BMD

## Engagements Capability in All Phases of Flight: Afloat and Ashore

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### Current Capabilities

#### Sea-Based Terminal



SM-2  
Blk IV  
(2008)  
Near Term



SM-6  
BMD  
(2015)

#### Standard Missile (SM-3)



Blk I / IA / IB  
2004/2006/2014

#### Aegis Ashore Romania



Aegis Ballistic Missile  
Defense Signal Processor  
(BSP) Upgrade  
(2012)



Aegis Multi-Mission  
Signal Processor  
(MMSP) Upgrade  
(2014)

Radar System  
AN/SPY-1

Open  
Architecture (2014)



#### Aegis BMD



Vertical  
Launching  
System Mark 41

### Future Capabilities

#### Standard Missile (SM-3)



Blk IIA  
(2018)



Notional



#### Aegis Ashore Poland

### Overarching

- Engage on Remote in 2018
- Additional Capability Enhancements across the Weapon System and Radar
- Foreign Military Sales





# GMD

## Midcourse Engagements

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### Current Capabilities

- Engages ICBMs and IRBMs
- Up to 44 Ground-Based Interceptors
- GMD Fire Control nodes in CO and AK
- Intercept Flight Test Successes - 4 for 7 using operationally configured interceptors

#### Missile Fields



3 MFs at FGA

#### GBI



5 Sites, VAFB

#### Communications



IFCS Data Terminal  
(FGA, VAFB, FTDNY)

#### Fire Control Nodes



FGA FDC w/ 49<sup>th</sup> MD Bn  
& MDIOC MDE w/100<sup>th</sup> MD Bde



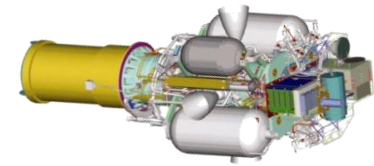
CTV-02+  
22 January 2016



FTG-06b  
22 June 2014

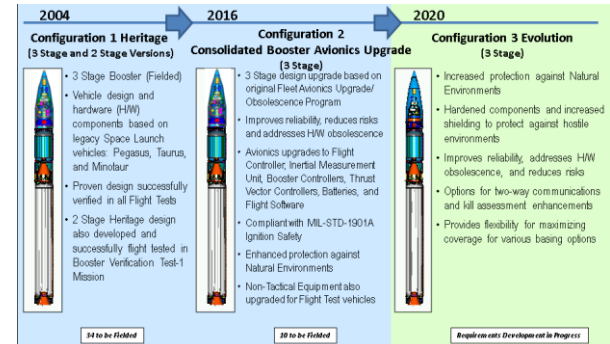
### Future Capabilities

#### Exoatmospheric Kill Vehicle



Notional Illustration

#### Booster Development Evolution



#### Overarching

- Increase GBI / RKV Reliability / Availability
- Two-Way KV Comms and Kill Assessment Enhancements
- 2/3-Stage Selectable Booster
- Increased Protection against Natural and Hostile Environments



# THAAD

## Terminal Engagements

DISTRIBUTION STATEMENT A.  
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### Current Capabilities

#### THAAD Launcher



- 8 Interceptors per Launcher
- 6 Launchers per Battery
- Highly mobile

#### THAAD Interceptor



- Hit-to-Kill Lethality
- Single Stage Solid Booster w/ TVC
- Gimbaled IR Seeker

#### AN/TPY-2 (TM) Radar Component

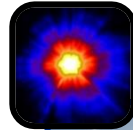


- Target Discrimination
- Hit Assessment
- In-flight Interceptor Comm.

#### THAAD Delivery to PRSK



March 7, 2017



FTO-02 E2a  
31 October 2015

#### THAAD Fire Control & Communication Component (TFCC)



TOS w/ 36kW  
generator



LCS w/ 36kW  
generator



ASV & CSV

- Tactical Operations Station (TOS)
- Launch Control Station (LCS)
- Antenna Support Vehicle (ASV)
- Cable Support Vehicle (VCV)

- Endo-and-Exo- atmospheric engagements
- Shoot-Look-Shoot Capability
- Hit-to-Kill
- Intercept Flight Test Successes –  
13 for 13 since July 2006

### Possible Future Capabilities



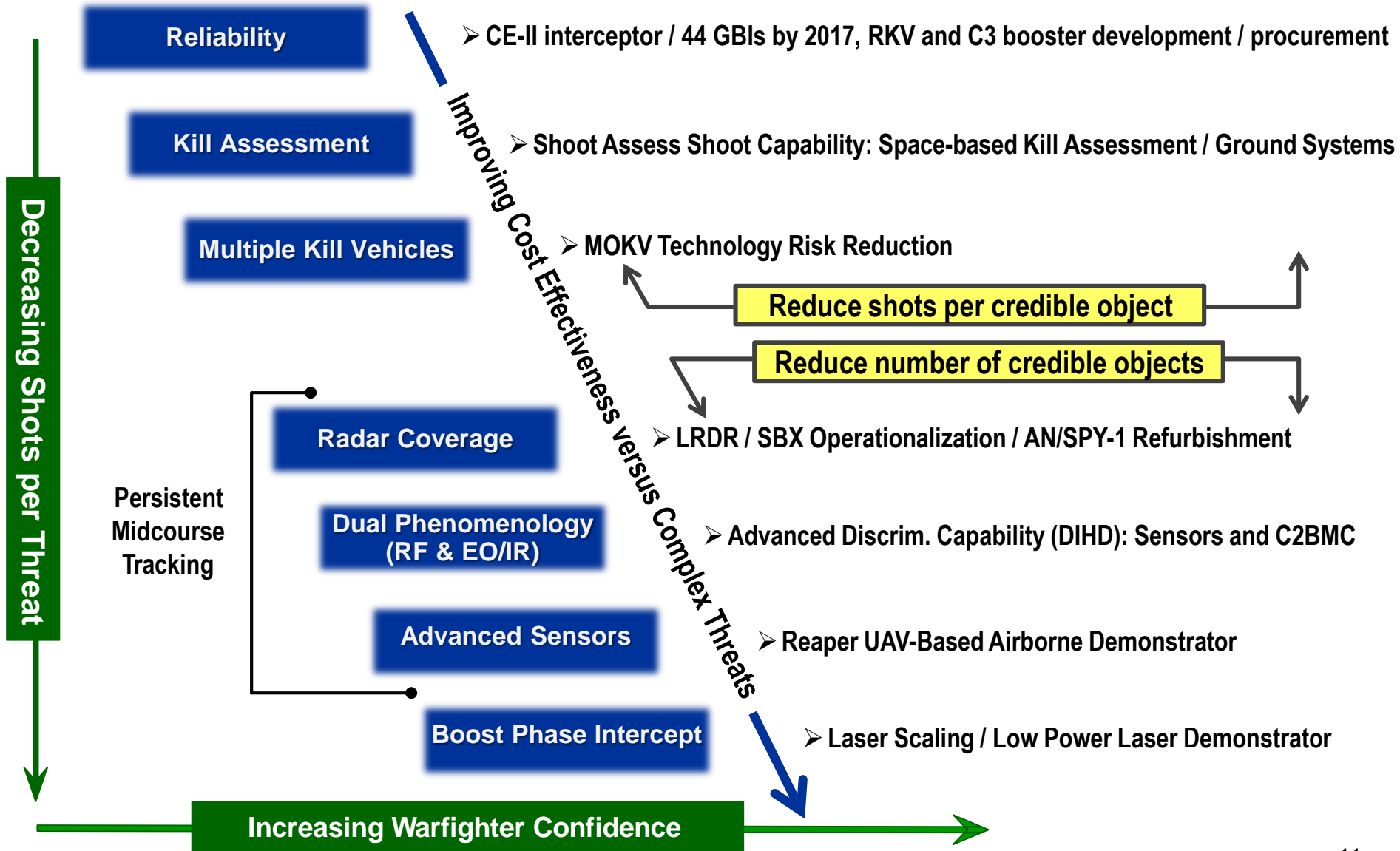
#### Overarching

- 360 degree sensor augmentation
- Integrated THAAD and Lower Tier Interceptor
- Remote Launcher Capability
- Enhanced Debris Mitigation
- Launch on BMD System Track
- IAMD Battle Command System (IBCS) Integration
- Expanded THAAD Battlespace
- Increased Foreign Military Sales



# DV: Advanced Technologies

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# FY17 NDAA Directives

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- **Develop a Medium Range Discriminating Radar for the defense of Hawaii**
- **Establish a Program of Record to develop and field a system to defeat Hypersonic boost-glide and maneuvering ballistic missiles**
- **Define a concept and design for a Space Based Ballistic Missile intercept and defeat layer**
- **Increasing Allied contributions to an integrated BMDS against the growing Iranian threat**



# Summary

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- **Support the Warfighter by providing reliable, tested and operationally effective systems**
- **Develop relevant capabilities to counter the continually evolving threat**
- **Harness the innovation of industry to develop the next implementation of Missile Defense capabilities**
- **Optimize all available MDA resources to provide an integrated and affordable missile defense capability**







# **2017 AUSA Missile Symposium**

**US Army Aviation and Missile Command**

**MG Doug Gabram**

**11 APR 2017**



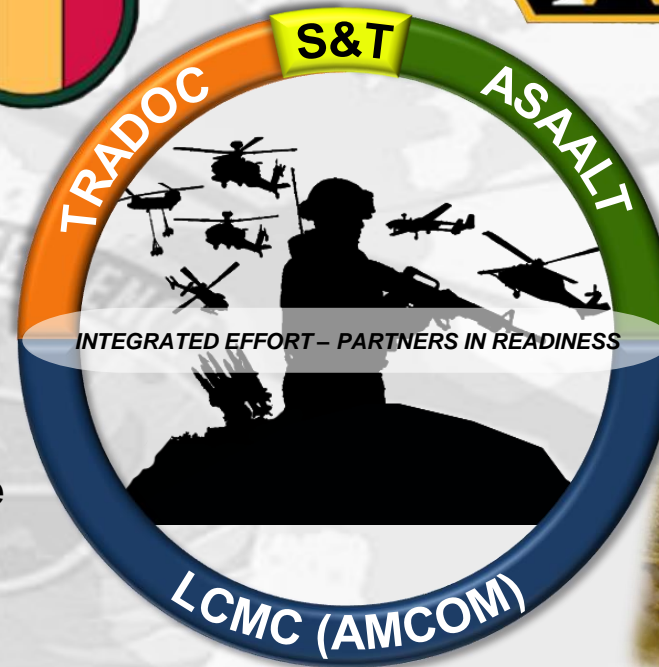
# AMCOM: What We Do

1. Define Requirements
2. Training



## Core Competencies

1. Support to Acquisition
2. Sustainment Logistics
3. Organic Industrial Base
4. Field Maintenance
5. Calibration
6. Security Assistance
7. RD&E
8. Contracting



1. Development
2. Production
3. Fielding



Operating Forces



INVOLVEMENT IN ALL PHASES OF THE ACQUISITION LIFE CYCLE

Materiel Solutions  
Analysis

Technology  
Development

Engineering  
Manufacturing &  
Development

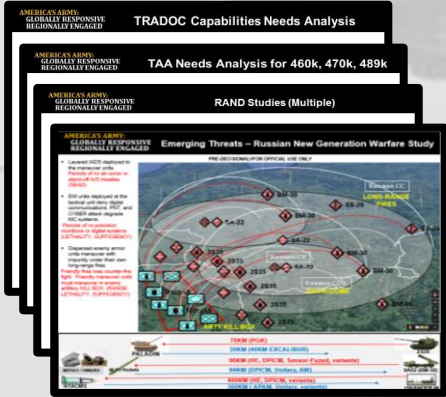
Production &  
Deployment

Operations &  
Support

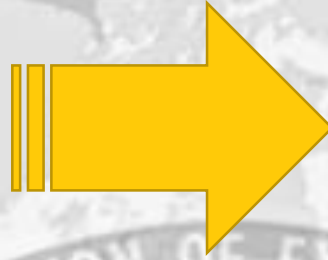
DEMIL



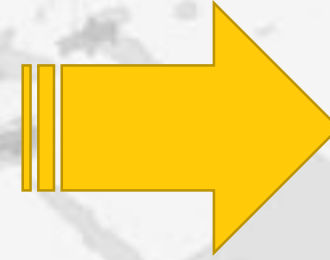
# Operationalizing AMCOM: Avenger Requirement



**Strategic  
Analysis**



**#1 Priority:  
SHORT RANGE AIR  
DEFENSE**



**Near Term Need:  
Avenger Systems**



**Team Effort<sub>2</sub>**



**Production &  
Sustainment**



**Supply Chain Management &  
Integration**



**Refurbishment of Avenger  
systems slated for divestment**



**Contracting Assistance for  
Obsolescence efforts**



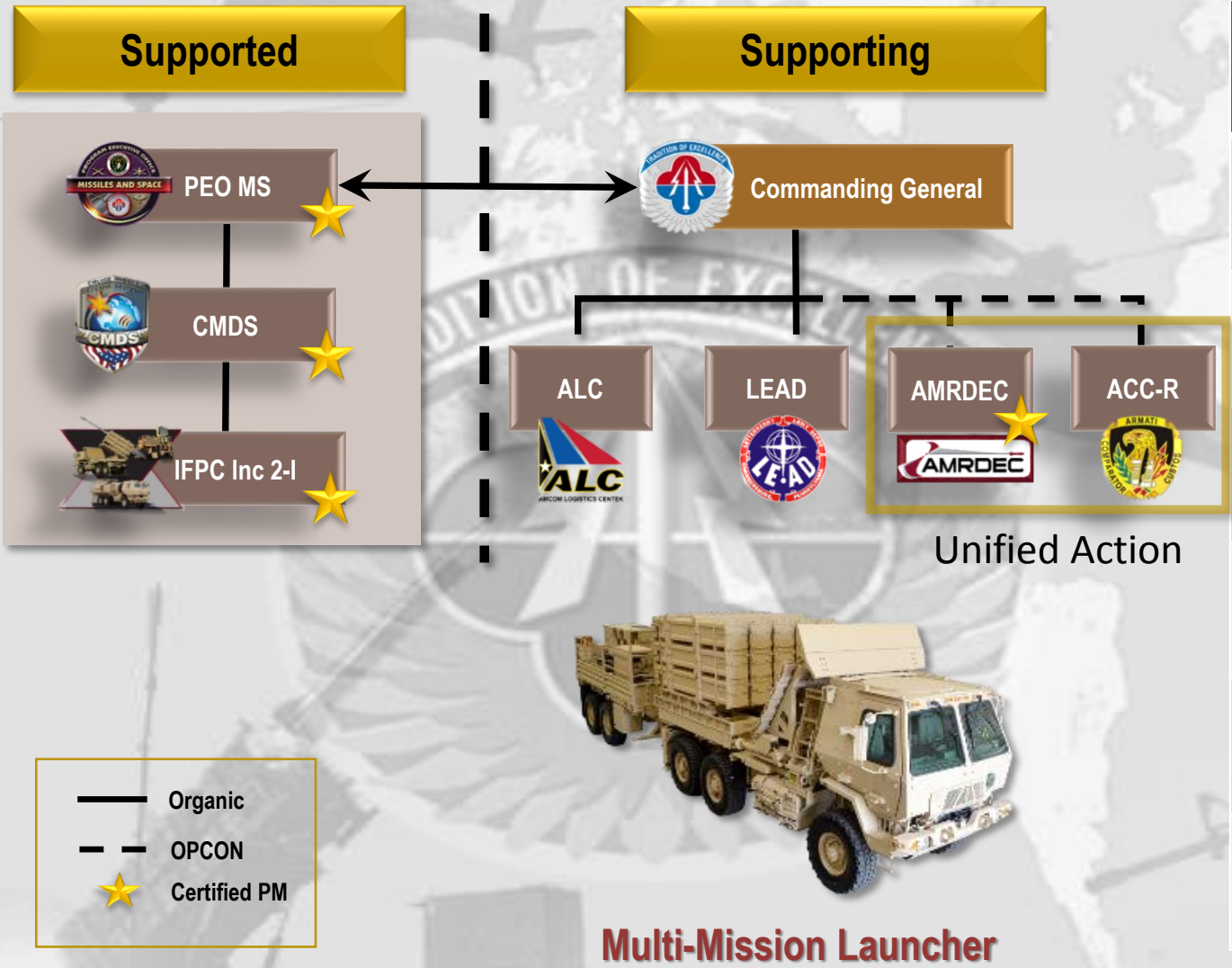
**Research, Design, & Analysis  
for Long-Term Solution**



**Delivery to Army**



# Innovative Acquisition Support: Multi-Mission Launcher



OEM Roles	AMCOM as OEM	
Engineering		Aviation & Missile Research, Design, and Engineering Center
Testing		Aviation & Missile Research, Design, and Engineering Center
Supply Chain Management		AMCOM Logistics Center
Contracting		Army Contracting Command - Redstone
Production		Letterkenny Army Depot
Quality	 	AMCOM Logistics Center And Letterkenny Army Depot

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# PROGRAM EXECUTIVE OFFICE MISSILES AND SPACE

## 2017 AUSA Missile Symposium

Using Technology and Innovation to Obtain Increased Capability and Readiness for Systems



Mr. Barry Pike, SES  
Program Executive Officer  
Missiles and Space

11 April 2017

DISTRIBUTION A.  
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# Program Executive Officer, Missiles and Space



## Lines of Effort

**Operate Across  
Multiple  
Domains**

***Provide COCOMs multiple-domain  
capabilities***

**Build Partner  
Capacity**

***Assure allies and deter adversaries***

**Support Full  
Spectrum  
Operations**

***Counter emerging threats:  
Cyber, EW, UAS***

**Enhance the  
Acquisition  
Process**

***Meet the operational demands of  
the Warfighters***

***Win in a  
Complex  
World***

***"The Strategic Portfolio Analysis Review (SPAR) has validated a number of critical capability requirements in key program areas... These include: air and missile defense, long-range fires, munitions, mobility, lethality and protection of brigade combat teams"...***

***- LTG MURRAY, Deputy G-8***





18TH

# AUSA MISSILE SYMPOSIUM-2017

## Panel 3

**Prioritizing IR&D toward key technology and innovation for rapid transfer and soldier use.**

### Members

Mr. Dan Verwiel  
Mr. Ronald J. Eckels  
Mr. Scott Arnold  
Mr. James R. Smith

### Moderator

Mr. Mike Van Rassen

# ***Prioritizing IR&D Toward Key Technology and Innovation For Rapid Transfer and Soldier Use***

THE VALUE OF PERFORMANCE.

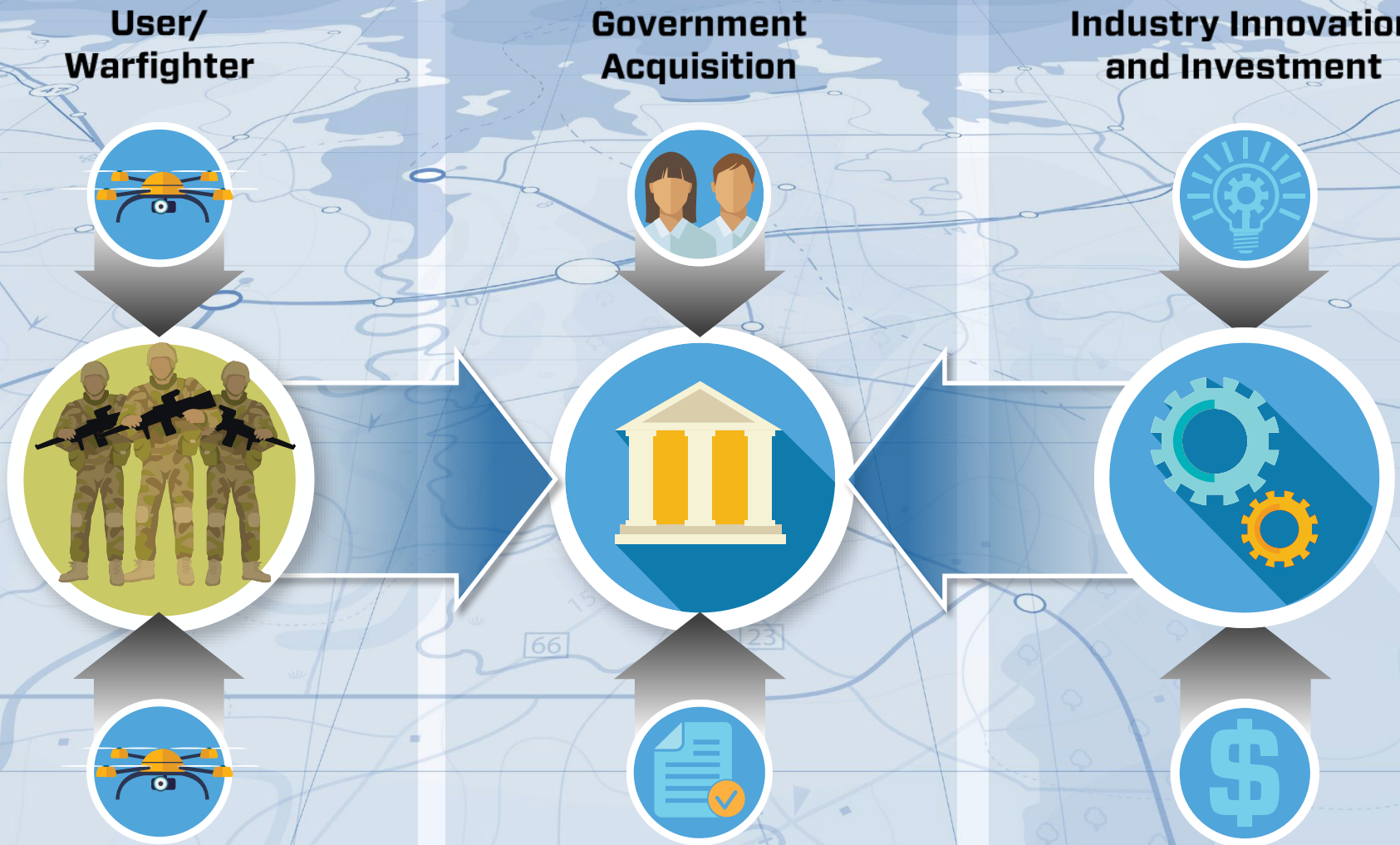
***NORTHROP GRUMMAN***

AUSA Missile Symposium 2017

**Dan Verwiel**

Sector Vice President and General Manager  
Northrop Grumman Corporation

# A Partnership





# DRAKE: Overview

**NORTHROP GRUMMAN**



## **Drone Restricted Access Using Known EW**

# Partnership in Action: DRAKE

**NORTHROP GRUMMAN**

## THE STORY

Army JUONS  
for C-UAS

Northrop Grumman  
invested to repurpose  
existing technology  
for C-UAS

JUONS to  
C-RAM PO

**DRAKE**  
demonstrated at  
Black Dart

## THE OUTCOME

DRAKE tested  
at YPG

Government  
acquired  
DRAKE  
technology

Units started  
deploying

SEPTEMBER 2016

MARCH 2017

***THE VALUE OF PERFORMANCE.***

***NORTHROP GRUMMAN***





# Boeing Integrated Air & Missile Defense (IAMD)



*Ronald Eckels, Senior Director*

*April 11, 2017*



The background of the entire slide is a composite image. It features several missiles in flight against a dark blue space background with a glowing blue grid pattern. The Earth's horizon is visible in the center. In the lower portion, there are images of missile launchers and transport vehicles on the ground, some with missiles being launched. The text 'AUSA Missile Symposium' is prominently displayed in the upper center.

# AUSA Missile Symposium

Scott Arnold  
Vice President, Lower Tier IAMD

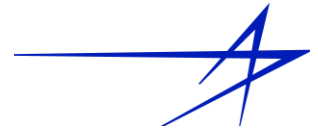
LOCKHEED MARTIN

CLEARED FOR PUBLIC RELEASE

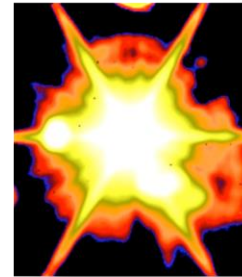
PIRA #ORL201704002



# Prioritizing IRAD Investments



- **Informed by Customer Needs**
  - Chief of Staff of the Army's Priorities
  - TRADOC Capability Gaps
  - PEO 30 Year Roadmaps
- **Driving Technology Maturation**
  - Key Technology Roadmaps
  - Synergize with S&T Community
  - Supply Chain Engagement
- **Leveraging Core Competencies**
  - Integrated System Solutions
  - Hit-to-Kill Interceptors
  - Affordable Designs





# Delivering Capability for Soldier Use



- **Focused on Delivering a Capability**
  - Leverage Existing Systems
  - Integrate to Provide More for Less
  - Cross Domain Mission Capability
  - Thickened, Layered, 360° IAMD
- **Program and Product Examples**
  - Hellfire Longbow for SHORAD
  - HTK Technologies Applied to CRAM
  - Lower Tier AMD Sensor
- **Challenges**
  - Threat Evolution Outpacing Development Cycle
  - Requirement Shifts



***Supporting the Warfighter by Addressing Critical Capability Gaps***



# Raytheon Missile Systems R&D

J.R. Smith  
Director

Advanced Land Warfare Systems

11 April 2017

This presentation contains no technical data as defined under ITAR 120.10

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# Raytheon Company Businesses



Raytheon Company  
Tom A. Kennedy

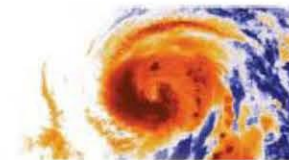


**Integrated Defense Systems**  
Wes Kremer

**Intelligence, Information and Services**  
David C Wajsglas

**Missile Systems**  
Taylor W. Lawrence

**Space and Airborne Systems**  
Richard R. Yuse





# Missile Systems Programs

## Air & Missile Defense Systems



J. Mitch Stevison

- Standard Missile-3 (SM-3®)
- Standard Missile-6 (SM-6™)
- Exoatmospheric Kill Vehicle
- Israeli Cooperative Programs:
  - David's Sling Weapon System
  - Iron Dome Weapon System
- International Missile Defense
- Advanced Missile Defense Concepts
- Missile Defense Targets

## Air Warfare Systems



J. Mike Jarrett

- AMRAAM®
- AIM-9 Sidewinder Family
- Griffin®
- HARM™ Targeting System
- HARM®
- JSOW
- Maverick®
- MALD®
- Paveway™
- SDB II™
- Tomahawk

## Naval and Area Mission Defense



Rick M. Nelson

- Phalanx® Close-in Weapon System
- Land-Based Phalanx Weapon System
- RAM™
- RAM MK49 Guided Missile Launching Systems
- SeaRAM™ Anit-Ship Missile Defense System
- Sea- and Land-Based Sparrow™
- Sea- and Land-Based ESSM®
- Standard Missile-1
- Standard Missile-2
- Peregryn® Protection Systems
- Small Ship Weapon Solutions
- Integrated Weapon System Management Centers
- MK698 Missile Guidance Test Systems

## Land Warfare Systems



Duane P. Gooden

- Excalibur®
- Javelin
- TALON™
- Stinger™
- TOW®
- 2nd Gen/3rd Gen FLIR
- TOW Improved Acquisition System (ITAS)
- Long Range Advanced Scout Surveillance System (LRAS3)
- Integrated Sensors, Surveillance and Security
- Soldier Weapon Sights and Systems
- Integrated Vehicular, Individual and Crew Served Fire Control Systems

## Advanced Missile Systems



Thomas R. Bussing

- Active Denial System
- Advanced Nonkinetic Systems
- Advanced Sensors
- Advanced Missiles
- Advanced Tactical Targeting Technology
- Autonomous Systems
- Collaborative Systems
- Counter – RAM, CM and UAS
- Hypersonics
- Loitering Weapons
- Long Range Precision Fires
- Missile Defense Tech
- Ship Self-Defense and Lasers
- Space
- Unmanned Systems
- Urban Warfare and Small Weapons

# Advanced Missile Systems

## Vision

To be the World's Premier Missile and Non-Kinetic Weapon Development House

### ■ Main growth engine for Missile Systems:

- Closely tied to the core Product Lines
- Broad portfolio of programs and pursuits
- Mix of unclassified and classified programs
- Developer of kinetic and non-kinetic effects

### ■ Headquartered in Tucson, AZ

### ■ Primary customers include:

- RMS Product Lines
- DARPA
- AFRL, RDECOM and ONR service labs
- U.S. Air Force, U.S. Army, U.S. Navy, USMC
- Sandia National Lab



# Raytheon Capability Areas



## C5ISR

Raytheon integrates proven radars, sensors, navigation systems and cyber technology to enable customers to collect, analyze and distribute information in real-time, giving them new ways to perceive and manage the world.



## ELECTRONIC WARFARE

Raytheon's advanced electronic warfare systems and capabilities give our warfighters the continued strategic advantage to effectively and safely execute their mission in the modern threat environment.



## MISSILE DEFENSE

Raytheon's proven missile defense systems deliver protection against a broad range of current and emerging threats — ensuring peace of mind for the US and its allies, and making Raytheon the world's most trusted partner in missile defense.



## PRECISION WEAPONS

Raytheon's reliable and cost-effective precision weapons hit the target, and only the target, while protecting warfighters, avoiding harm to nearby people and structures, and helping to manage the cost of battle over the long term.



## TRAINING & SERVICES

Raytheon's innovative approaches and proven tools help customers successfully train staff, sustain skills, and maintain operations for a wide variety of high-consequence missions worldwide.





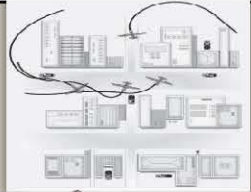
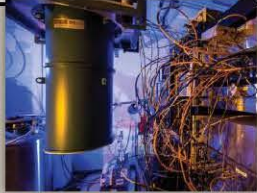


## CYBER

With decades of cyber and intelligence expertise, Raytheon offers unmatched end-to-end capabilities that help customers secure their space and confidently navigate the cyber domain.



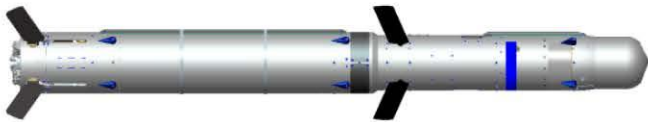
# Representative Raytheon Technologies

[http://www.raytheon.com/news/technology\\_today](http://www.raytheon.com/news/technology_today)

<b>RF Sensing</b> 	<b>EO/IR</b> 	<b>C3I/ Analytics</b> 
<ul style="list-style-type: none"> <li>• AESA radars</li> <li>• GaN MMICs</li> <li>• Collaborative Adaptive Sensing of the Atmosphere</li> <li>• Next generation, high-performance, mixed signal circuits</li> </ul>	<ul style="list-style-type: none"> <li>• Focal plane arrays</li> <li>• Hyperspectral sensing</li> <li>• Laser communications</li> <li>• High energy lasers</li> <li>• Earth observation</li> <li>• Computational imaging</li> </ul>	<ul style="list-style-type: none"> <li>• Automated language translation</li> <li>• Particle flow filters</li> <li>• UAV control algorithms</li> <li>• GPS and navigation systems</li> </ul>
<b>Computing, Cyber</b> 	<b>Systems Enablers</b> 	<b>Materials, Other</b> 
<ul style="list-style-type: none"> <li>• Cyber analytics</li> <li>• Embedded cryptography</li> <li>• Quantum computing</li> <li>• System integrity</li> <li>• BareMetal cybersecurity technology</li> <li>• Cross domain solutions</li> </ul>	<ul style="list-style-type: none"> <li>• Power, energy, thermal management</li> <li>• Modeling and simulation</li> <li>• Additive manufacturing</li> <li>• High performance processing</li> </ul>	<ul style="list-style-type: none"> <li>• Metamaterials</li> <li>• Hypersonic systems</li> <li>• High power microwave</li> <li>• Carbon electronics</li> <li>• Acoustic sensing</li> <li>• SiC electronics</li> </ul>

# Leveraging IRAD at Raytheon Missile Systems

- Strategic IRAD – new technologies with a broad range of applications
- Internally-funded new systems development
- Posturing for success in Technology Development
- Spiral growth for established programs



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# Maximizing the benefits of IRAD

- Stable roadmaps that clearly articulate capability and technology gaps
- Partnering with RDECs – leveraging mutual strengths and respecting each party's key interests – open and honest communications
- Collaboration with/between DARPA and Service labs and programs
- Get beyond “not invented here”
- Promote collaboration with innovative small companies
- Shared investment in demonstrations (shows interest and commitment)
- Industry can help connect government stakeholders
- Leverage international partners



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# PROGRAM EXECUTIVE OFFICE MISSILES AND SPACE

## Counter-Rocket, Artillery and Mortar (C-RAM)



C-RAM Program Directorate • ATTN: SFAE-MSL-CR • Redstone Arsenal, AL 35898



**Mr. Andy Anderson**  
**Functional Product Director**  
**Sense, Warn and Respond**  
**Counter-Rocket, Artillery and Mortar**  
**Project Office**



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# Capability and Readiness

## Lines of Effort

## Readiness – Future Warfighting Capabilities

**Operate Across Multiple Domains**

*Execute Air and Missile Defense Command & Control (C2) Convergence and Support Interoperability with Mission Command, Aviation, Fires, and C2*

**Build Partner Capacity**

*Participate/Support NATO Ground Based Air Defense (GBAD) Effort, 15+ Active Foreign Military Sales (FMS) Cases*

**Support Full-Spectrum Operations**

*Simultaneously Execute Existing Programs of Record, ONS/JUON Requirements, and European Reassurance Initiative (ERI) Efforts*

**Enhance the Acquisition Process**

*Recommend Tailored Milestone Documentation, Contract Offloading where Practical*



**C-RAM Intercept**



**ADAM/AMDPCS**



**RAM Warn**



**RRRP**



**TPQ-53**



**TPQ-50**



**M-LIDS**





# Major Initiatives



## Dynamic Clearance of Unplanned Fires (DCUF)



- Provides a real-time, automated airspace assessment for rapid clearance of fires by integrating and enhancing capabilities of FAAD/C-RAM C2, AMDWS/Fires Gateway, and AFATDS in the BDE Fires Cell

## Land-based Phalanx Weapon System (LPWS) for Cruise Missile Defense



- OSD Cost Assessment and Program Evaluation (CAPE) directed PD C-RAM to conduct LPWS Counter Cruise Missile (CCM) demo
- Requires bullet optimized to kill cruise missiles

## Counter-Unmanned Aerial Systems (C-UAS)



- Office of Primary Responsibility (OPR) for CENTCOM Joint Urgent Operational Need (JUON) required capability for detect, track, and defeat of low, slow, small threats





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# PROGRAM EXECUTIVE OFFICE MISSILES AND SPACE

## Army Integrated Air and Missile Defense (AIAMD)



Mr. Mike Chandler  
Project Manager  
Integrated Air and Missile Defense  
Project Office



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# Capability and Readiness



## Lines of Effort

## Readiness – Future Warfighting Capabilities

**Operate Across Multiple Domains**

*Execute AMD Convergence, THAAD Integration, C2BMC Interoperability*

**Build Partner Capacity**

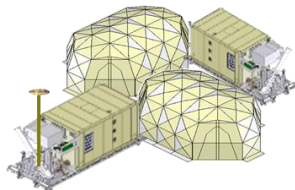
*Foreign Military Sales*

**Support Full-Spectrum Operations**

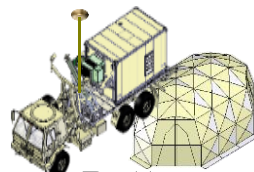
*Electronic Warfare and Cyber Improvements*

**Enhance the Acquisition Process**

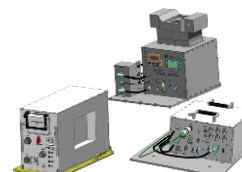
*Execute IBCS Milestone C*



**Battalion Engagement Operations Center**



**Battery Engagement Operations Center**



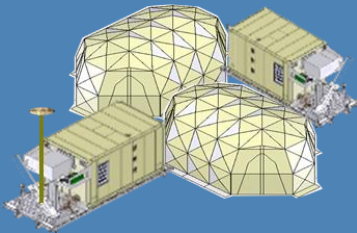
**A/B Plug and Fight Interface Kits**



**IFCN Relay**

# Major Initiatives

## IAMD Battle Command System (IBCS)



- Technology Development/Advancement
  - Current Capability:
    - Track Management: Small Business Innovative Research effort to maintain stability of target tracks when they transition between 2 Dimensional (Az, El) and 3 Dimensional data sources.
  - In Development:
    - Advanced countermeasure target filters
    - Advanced fire control capabilities
  - Future:
    - Multi-sensor data fusion to support Combat Identification



# PROGRAM EXECUTIVE OFFICE MISSILES AND SPACE

Lower Tier Project Office (LTPO)



Mr. William Breffeilh  
Deputy Project Manager  
Lower Tier Project Office



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# Capability and Readiness

## Lines of Effort

## Readiness – Future Warfighting Capabilities

**Operate Across  
Multiple Domains**

*PATRIOT - THAAD Integration*

**Build Partner  
Capacity**

*Participate/Support EUCOM, CENTCOM, PACOM Joint  
exercises and operational rotations*

**Support Full-Spectrum  
Operations**

*Field DPICC, PATRIOT Configuration 3+ and PAC 3 MSE*

**Enhance the  
Acquisition Process**

*Leverage FMS funds to mitigate obsolescence  
and increase readiness*



**Radar**



**Launcher Station**



**PAC-3 MSE Interceptor**



**South Korea PATRIOT Modernization Facility**





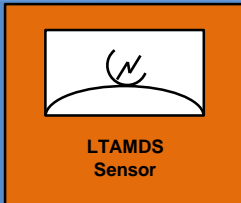
# Major Initiatives

## PATRIOT



- Efforts to increased readiness of US and International PATRIOT Force
- Field hardware and software improvements
- Initiatives to address readiness and obsolescence issues of fielded PATRIOT firing units
- Transition to the IBCS Architecture

## LTAMDS



- Competitive effort to meet Lower Tier Air and Missile Defense Sensor Requirements
- Enhance system performance mitigating capability requirements through increased Performance, Reduced O&S Costs and significant increase in RAM

## VCSA Initiatives



South Korea PATRIOT  
Modernization Facility

- Accelerate fielding 35th ADA BDE (Korea) with Config 3+ with PDB-8
- Develop and field Dismounted PATRIOT Information Coordination Central (DPICC)
- Activation of a AMD Test Detachment to support test mission

## Future Missile



- Begin Planning the Future Interceptor





# PROGRAM EXECUTIVE OFFICE MISSILES AND SPACE

## Cruise Missile Defense Systems (CMDS)



**COL Charles Worshim**  
**Project Manager**  
**Cruise Missile Defense Systems**  
**Project Office**



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# Capability and Readiness

## Lines of Effort

## Readiness – Future Warfighting Capabilities

**Operate Across  
Multiple Domains**

*IFPC Inc 2-I Block 1, 2nd Missile, Sentinel A3/A4,  
Homeland Defense Support*

**Build Partner  
Capacity**

*Stinger PROX, Sentinel IESP SW Development,  
FMS-Stinger and Sentinel*

**Support Full-Spectrum  
Operations**

*IFPC Inc 2-I Block 1, 2nd Missile, Sentinel A3/A4,  
Homeland Defense Support*

**Enhance the  
Acquisition Process**

*LEAD Sentinel A3 Integration, LEAD EVM Assist,  
IFPC Inc 2-I Prototype Depot Production, Stinger SLEP*



**Stinger**



**Avenger**



**Sentinel**



**Indirect Fire  
Protection Capability  
Increment 1**



**IFPC with Directed  
Energy Effector**





# Major Initiatives

## M-SHORAD



- Evaluate industry's solutions in providing an interim SHORAD capability to the maneuver force

## IFPC Inc 2- I



- **Block 1 - Counters CM and UAS**
  - New Multi-Mission Launcher (MML)
  - 2<sup>nd</sup> Missile IOC in FY22 provides initial RAM capability
- **Block 2 - Adds Counter-RAM capability by FY33**
  - New interceptor; Directed Energy possible

## Sentinel



- **Sentinel A4 AESA fielded in FY25:**
  - IFPC Block 2 sensor for RAM; Retains Aircraft Surveillance mission
  - Improved capability versus evolved threats

## Stinger MANPADS



- **Stinger Prox Fuze: Increased lethality against smaller UAS targets**
- FCOE pursuing Next Generation MANPADS capability

## Directed Energy



- Candidate for IFPC Block 2 versus RAM threats
- Could provide IFPC complementary coverage versus CM / UAS and RAM; low cost per engagement





# PROGRAM EXECUTIVE OFFICE MISSILES AND SPACE

## Missile Defense and Space Systems (MDSS)



**Mr. Steve Whitmore**  
Project Director  
Missile Defense and Space Systems  
Project Office



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# Capability and Readiness



## Lines of Effort

## Readiness – Future Warfighting Capabilities

**Operate Across Multiple-Domains**

*Exploit On-Orbit IR Sensors to expand mission envelope*

**Build Partner Capacity**

*Exploit On-Orbit IR Sensors with DoD and shared Early Warning partners*

**Support Full-Spectrum Operations**

*Support STRATCOM Theater Event System as the theater provider of Space Base Infrared Systems Events*

**Enhance the Acquisition Process**

*Leverage other DoD Space Base Infrared Systems development to expand mission envelope and share costs*



**SBIR Satellite**



**JTAGS Antennas**



**JTAGS Server Room**



**JTAGS Operator Room**



# Major Initiatives

## JTAGS Block II



- Improved Cyber Posture
- COTS based, improved RAM performance
- Capability to meet current and future upgrades
- Leveraging USAF and/or DoD Space Systems:
  - Mission processing software and algorithms
  - Scenarios for developmental and operational testing
  - Leveraging Community IPT solutions for networks and standardized message formats



# PROGRAM EXECUTIVE OFFICE MISSILES AND SPACE

## Precision Fires Rocket and Missile Systems (PFRMS)



**COL Chris Mills**  
**Project Manager**  
**Precision Fires Rocket and Missile Systems**  
**Project Office**



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# Capability and Readiness

## Lines of Effort

## Readiness – Future Warfighting Capabilities

**Operate Across  
Multiple Domains**

*Extend Munitions Ranges and  
Engage Moving Terrestrial and Maritime Targets*

**Build Partner  
Capacity**

*Foster Interest in HIMARS production, LRPF development,  
Munition and Launcher Upgrades*

**Support Full-Spectrum  
Operations**

*Expand GMLRS/ ATACMS suites, Address Inventory Shortages,  
Develop LRPF, Launcher Overhaul / RECAP, Integrate M-Code*

**Enhance the  
Acquisition Process**

*Facilitate Industrial Base  
and Use Flexible Contract Vehicles*



**M270A1 Multiple  
Launch Rocket System  
(MLRS)**

**M142 High Mobility  
Artillery Rocket  
(HIMARS)**

**Guided Multiple Launch  
Rocket System  
(GMLRS)**

**Army Tactical  
Missile System  
(ATACMS)**

**Long Range  
Precision Fires (LRPF)**





# Major Initiatives

## Field Artillery Launchers

*M270A1 Multiple Launch Rocket System (MLRS)*  
*M142 High Mobility Artillery Rocket System (HIMARS)*



- Overhaul and RECAP Fleet
- Fleet Expansion
- Common Fire Control System
- European Reassurance Initiative (ERI)

## Guided Multiple Launch Rocket System (GMLRS)



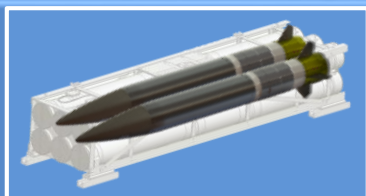
- Insensitive Munitions Propulsion System
- Extending range
- Anti-ship capability

## Army Tactical Missile System (ATACMS)



- Service Life Extension Program (SLEP)
- Improving Area Effects
- Anti-ship capability

## Long Range Precision Fires (LRPF)



- ATACMS replacement with 499Km range
- Open architecture supporting future payloads
- Reduced Logistics burden





# PROGRAM EXECUTIVE OFFICE MISSILES AND SPACE

## Close Combat Weapon Systems (CCWS)



Mr. Bill Ruta  
Product Director  
Close Combat Weapon Systems  
Project Office



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# Capability and Readiness

## Lines of Effort

## Readiness – Future Warfighting Capabilities

**Operate Across Multiple Domains**

*Plan and execute JUONS and REF 10 Liners for LMAMS, CWS and PFM requirements*

**Build Partner Capacity**

*Execute 48 Active Foreign Military Sales cases, Explore opportunities for foreign cooperative development*

**Support Full-Spectrum Operations**

*Address shortfalls in missile inventories; execute ERI requirements, Maintain high levels of readiness, Field TOW and Javelin modernization improvements*

**Enhance the Acquisition Process**

*Perform “murder boards” on contract requirements packages to shorten acquisition timeline, Co-location of Acquisition Center personnel*



**ITAS / TOW**



**Javelin**



**LMAMS**





# Major Initiatives

## TOW



- FY17-FY21 Multiyear Procurement
- TOW Obsolescence and Safety Program
- Supporting MCoE on TOW 3 Requirements Definition

## Javelin



- Stryker Integration FY17-FY18
- F & G Model Missiles
- Lightweight Command Launch Unit

## Lethal Miniature Aerial Missile System



- Capability Development Document currently in One-Star staffing
- JUONS Competition

## Containerized Weapon System



- Base Defense Response System Capability Development Document currently in staffing

## Bradley



- Integrating 3<sup>rd</sup> Generation FLIR into IBAS Fire Control Subsystem





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# PROGRAM EXECUTIVE OFFICE MISSILES AND SPACE

## Joint Attack Munition Systems (JAMS)



**COL David Warnick**  
**Project Manager**  
**Joint Attack Munition Systems**  
**Project Office**



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# Capabilities and Readiness

## Lines of Effort

## Readiness – Future Warfighting Capabilities

### Operate Across Multiple Domains

*Expand target set and platforms: C-UAV, C-FAC/FIAC, ground targets  
Integrate onto objective platforms: LCS, and current HELLFIRE platforms*

### Build Partner Capacity

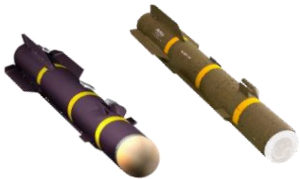
*Continue to execute 84 FMS cases totaling \$1.5B  
Support 27 LOA/P&A/Amendments valued at \$336M*

### Support Full-Spectrum Operations

*Production ramp-up and modernization for emerging threats  
Execute ONS and JUONS requirements for urgent needs*

### Enhance the Acquisition Process

*Modular and Incremental Approach  
Plan for launcher convergence and JAGM/HELLFIRE convergence*



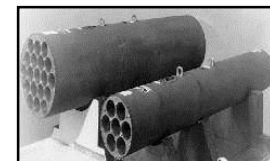
**JAGM/Hellfire**



**M299 Launcher**



**Hydra Rocket System**



**Hydra Rocket Launcher**





# Major Initiatives

## HELLFIRE



- L7A fielding for C-UAS/FAC/FIAC
- Littoral Combat Ship integration
- Facilitization to increase production
- HELLFIRE Missile /Launcher obsolescence

## Joint Air to Ground Missile (JAGM)



- Low Rate Initial Production and Full Rate Production
- Define Increment II
- Objective platform integration

## Aviation Rockets and Small Guided Munitions (ARSGM)



- Guided/Unguided Production
- Modular Weapon System ICD
- ONS and JUONS Support

