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U.S. Army Research, Development and Engineering Command

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U.S. ARMY RDECOM

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Extended Area Protection and Survivability (EAPS) ATO

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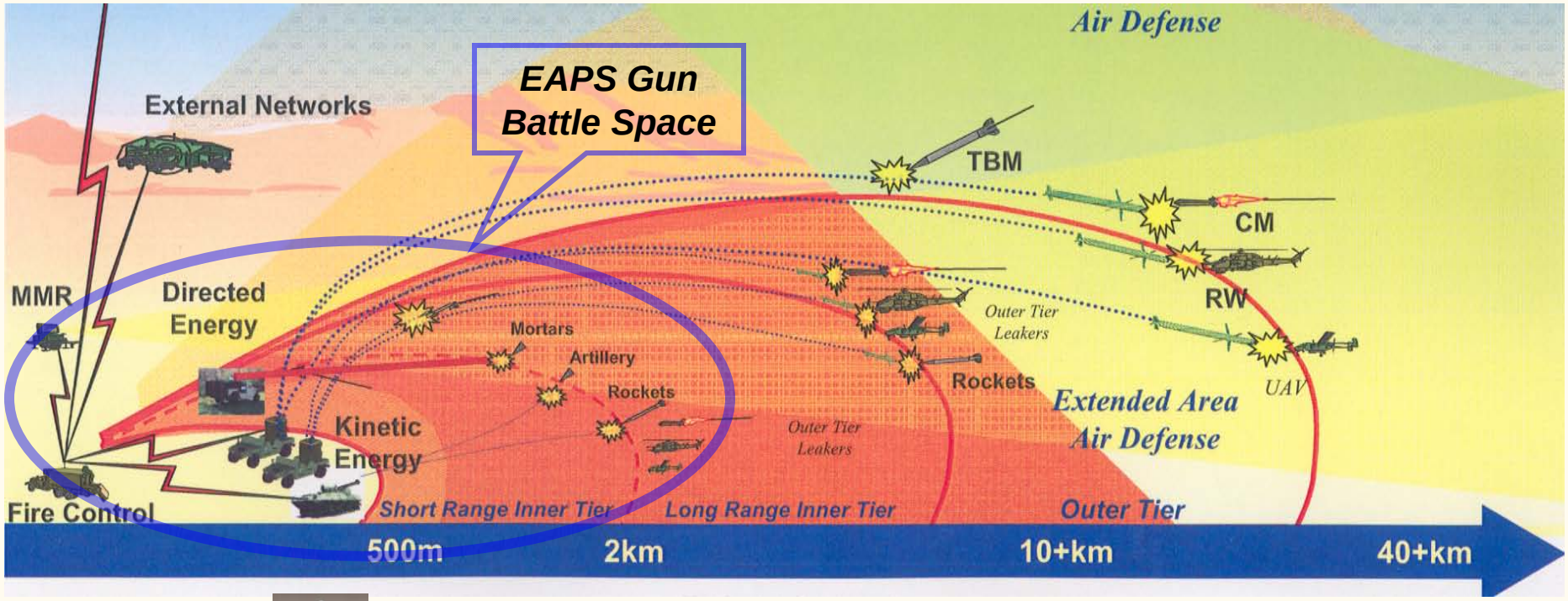
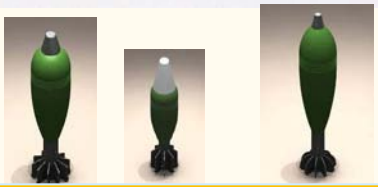
Presentation Structure

A. Program Overview & Update

B. Interior Ballistic Evolution of EAPS Interceptor

Program Goal and EAPS Battle Space





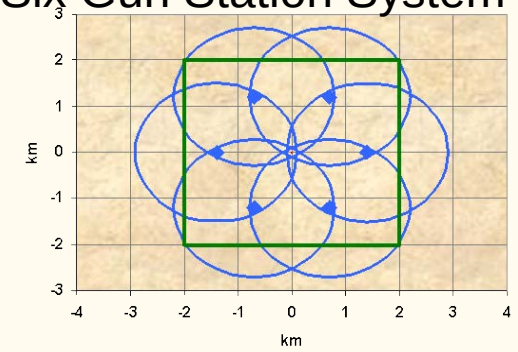
Target List

- Rockets: 107 mm-240 mm
- Artillery: 122 mm-152 mm
- Mortars: 60 mm – 120 mm

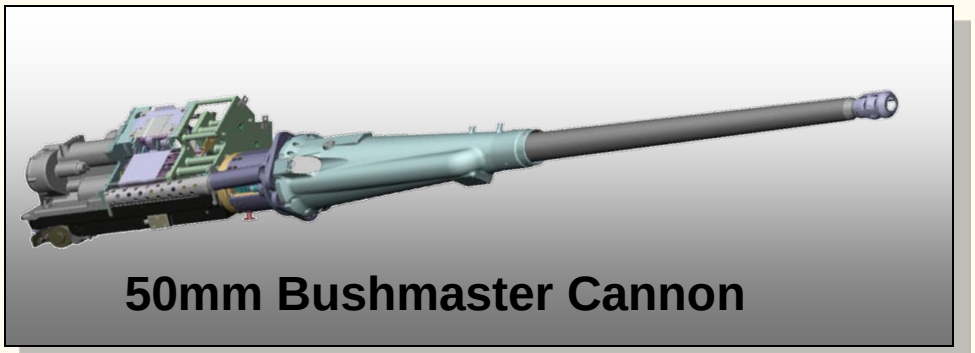
- Goal is to Develop Technologies for 360 Degree Mobile Air Defense Against Rockets, Artillery and Mortars (RAM)

- ARDEC ATO Program Pursuing Gun Based Solution for Short Range Inner Tier – Need to fill range Gap of present systems

Six Gun Station System



EAPS Gun Baseline Concept



50mm Bushmaster Cannon

RF Data Link

Radar Track

Forward Fragmentation Warhead Detonation

Mid-Flight Course Correction

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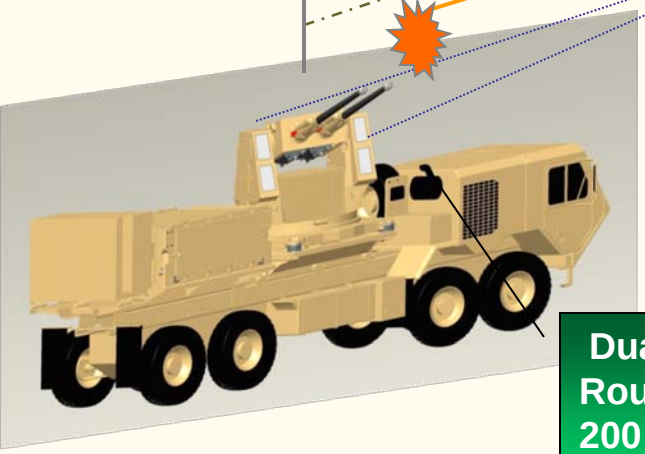
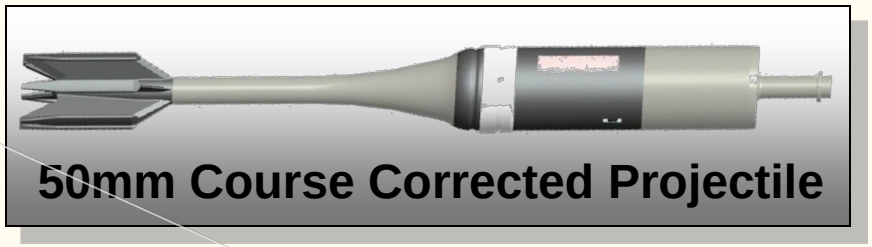


Dual Barrel,10 Round Burst at 200 Shots per Minute Per



50mm Course Corrected Projectile

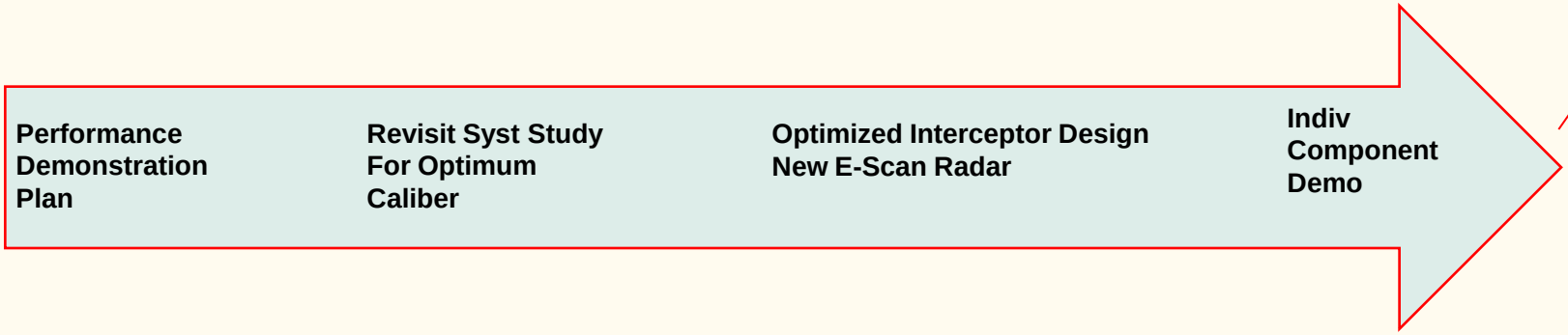
Phase II Program Goals and Objectives

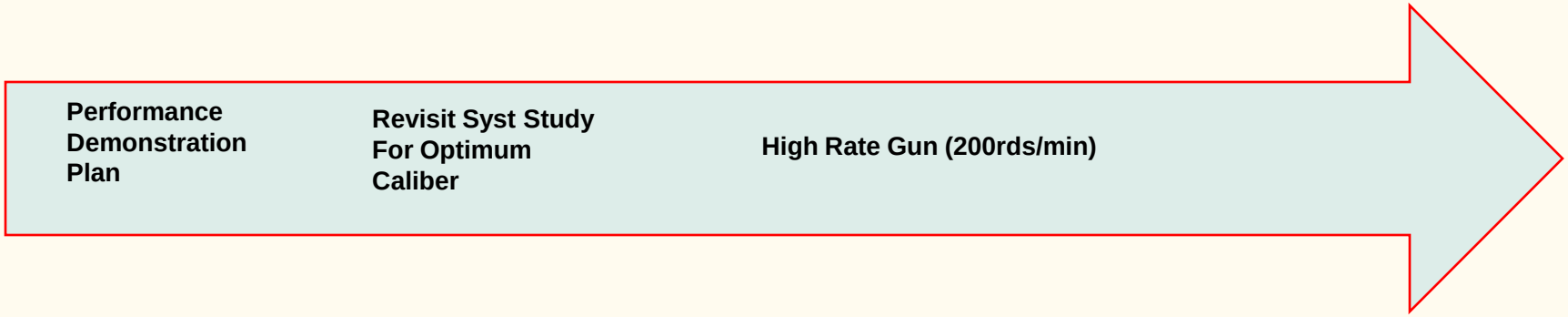
- Demonstrate a prototype 50mm auto cannon that fires at 200 rds/min w/ a feed system for a ten round burst.
- Demonstrate a fire control sensor & commo station to simultaneously track burst of ten interceptors and two threats and command the ten interceptors to maneuver and warhead function.
- Demonstrate a 50mm cartridge to meet threshold performance.

Demonstrate integrated system (System Level TRL-6) by defeating two stationary threats in a simultaneous emulated scenario.

EAPS Gun ATO
Integrated Demo Roadmap

FY14





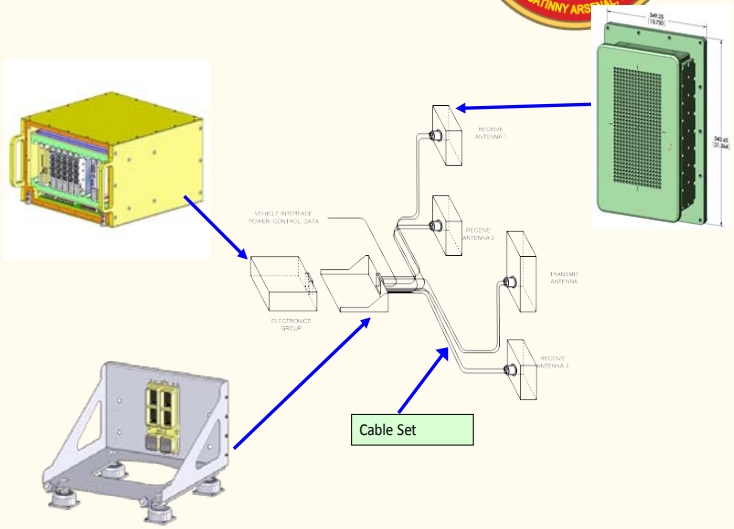
Mid FY15

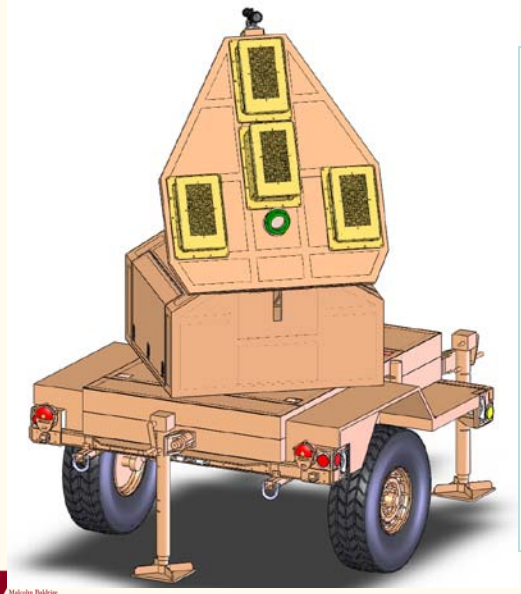
EAPS Gun System
HEMTT Mount

- **Transportable**
- **Meets Mobility Requirements**
- **More Cost Effective Than the Stryker – Stryker Also An Option**

EAPS Radar/Fire Control Integrated Demo

- 512-element Transmit Antenna based on PPS with improved cooling
- 512-element Receive Antennas (3) based on PPS
- 1 meter interferometer baseline for high angular accuracy
- PPS electronics group with upgraded processors
- Fire control software adapted from PPS
- Multi-target tracking and RF communications





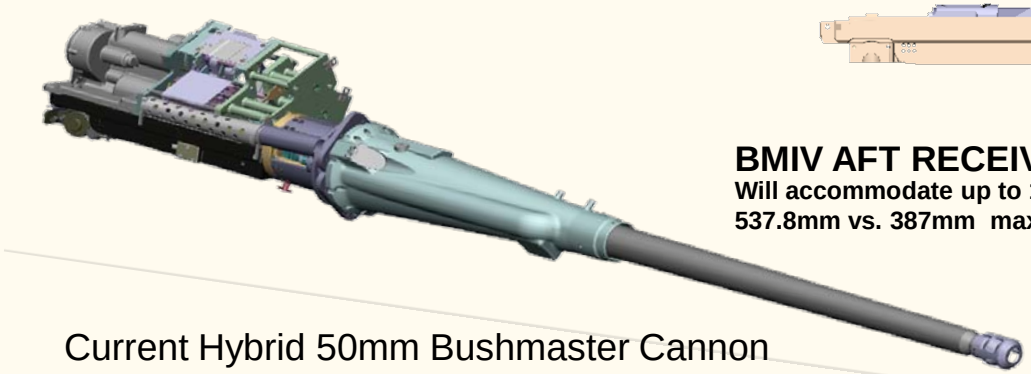
EAPS Fire Control Sensor

Wide Electronic Field of View For Multiple Simultaneous Tracks

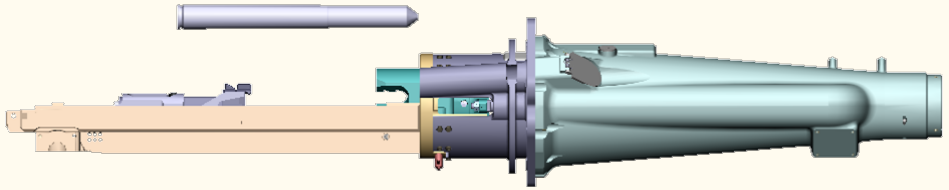
9 dB Greater Sensitivity than Previous Gen Radar for Increased Performance

Designed & Fab Specifically For EAPS Mission

50mm Bushmaster Cannon Plan



Current Hybrid 50mm Bushmaster Cannon
Demonstrated @ 112 Rds/Min



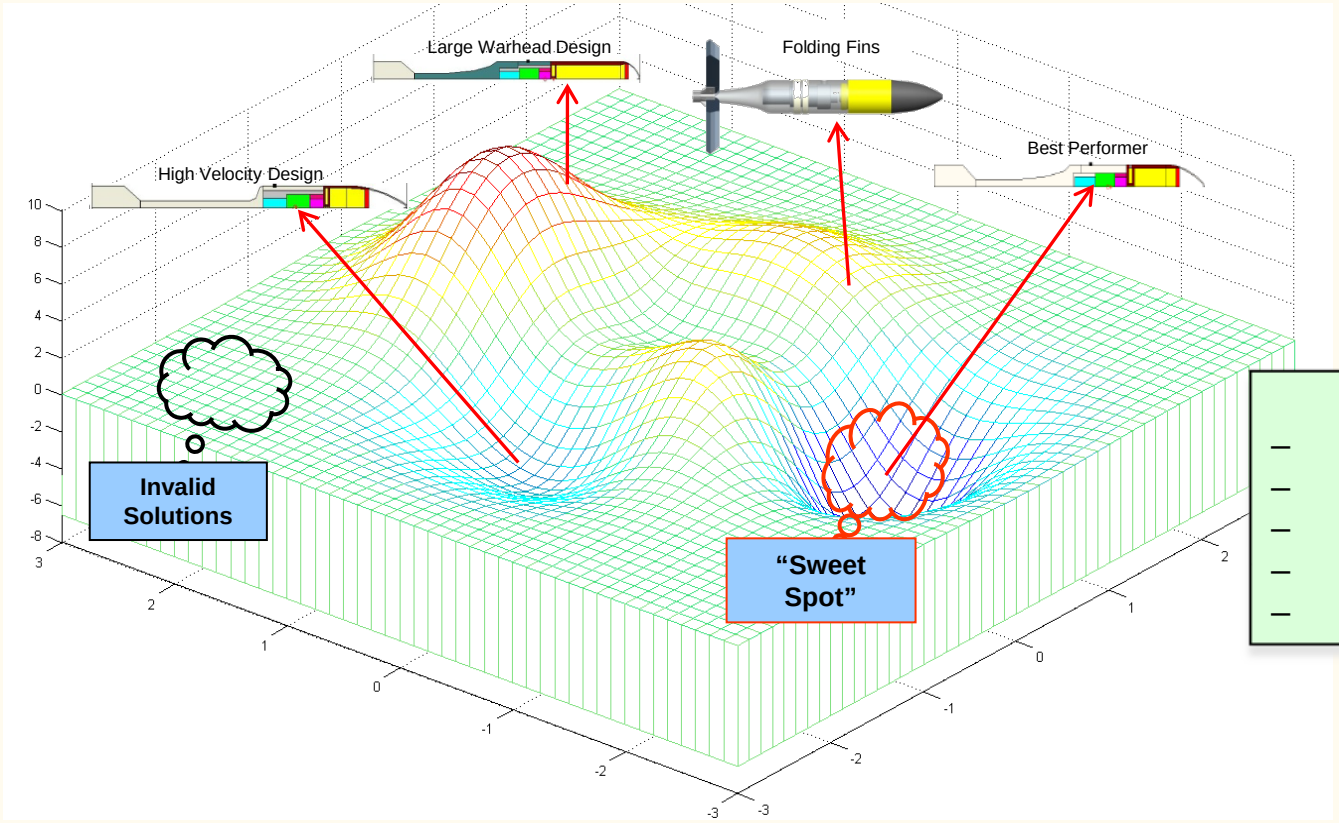
BMIV AFT RECEIVER with BMIII BREECH & FWD RECEIVER
Will accommodate up to 150.8 mm additional cartridge length
537.8mm vs. 387mm max overall cartridge length

Optimized EAPS Cartridge

Optimized Gun to Accommodate New Cartridge
Still 50mm, 200 Rds/Min Firing Rate
Specific EAPS Chamber & Receiver Design
Three Year, $8.5M to Demo

Interior Ballistic Evolution of EAPS Interceptor

Optimization Design Space with Modeling & Simulation

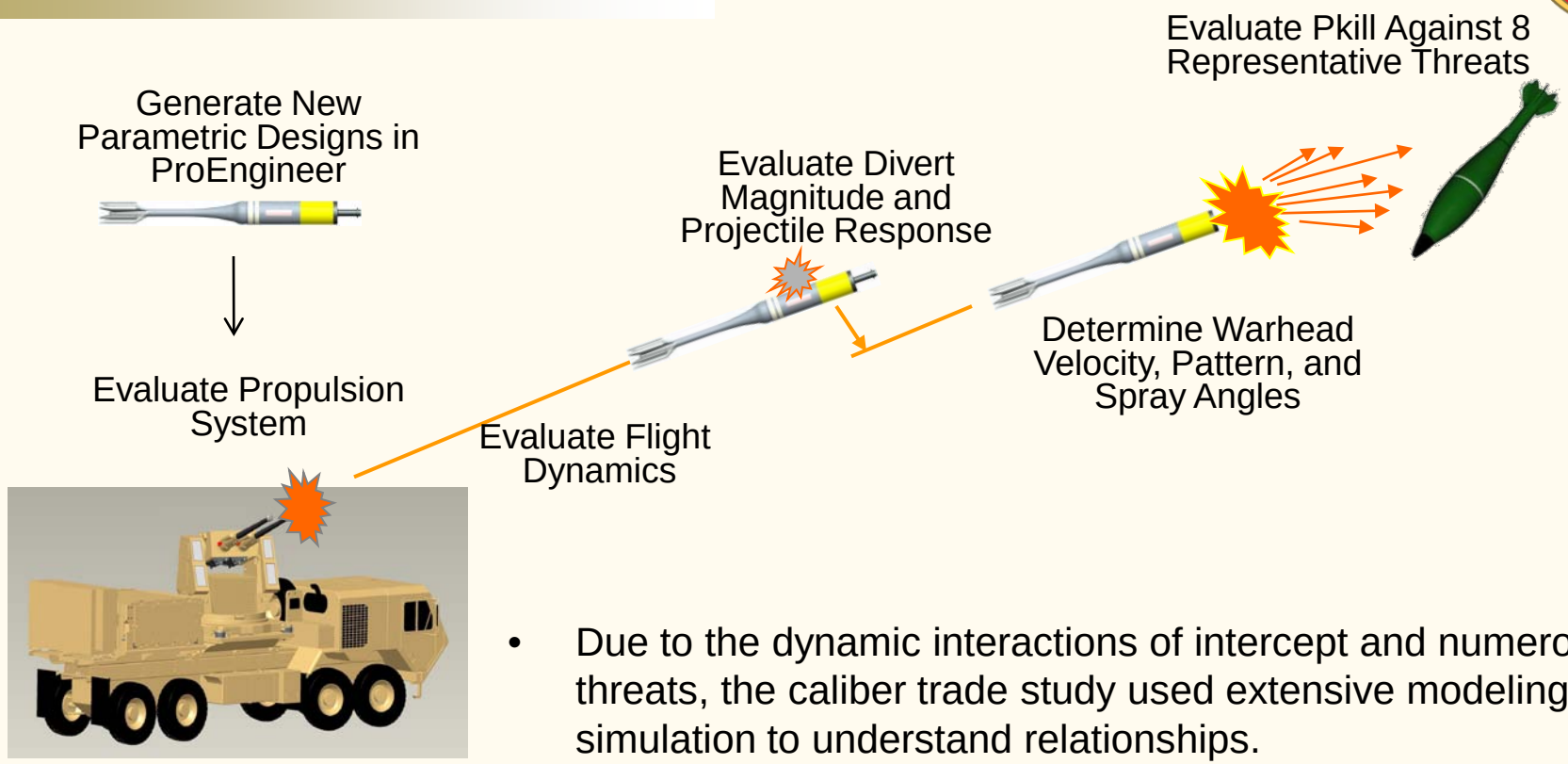


Design Goals

- Reduced Drag Air Frame
- Increase Muzzle Energy
- Reduce Parasitic Volume
- More Lethality from Warhead
- Explore Optimum Caliber

– What is the best caliber to maximize system performance?
  – High degree of variable dependencies.
  – Evaluate thousands of variations with Matlab algorithm.
– Optimize each projectile caliber individually and compare results.
  – Perform propulsion subsystem optimization with an unconstrained cartridge size.

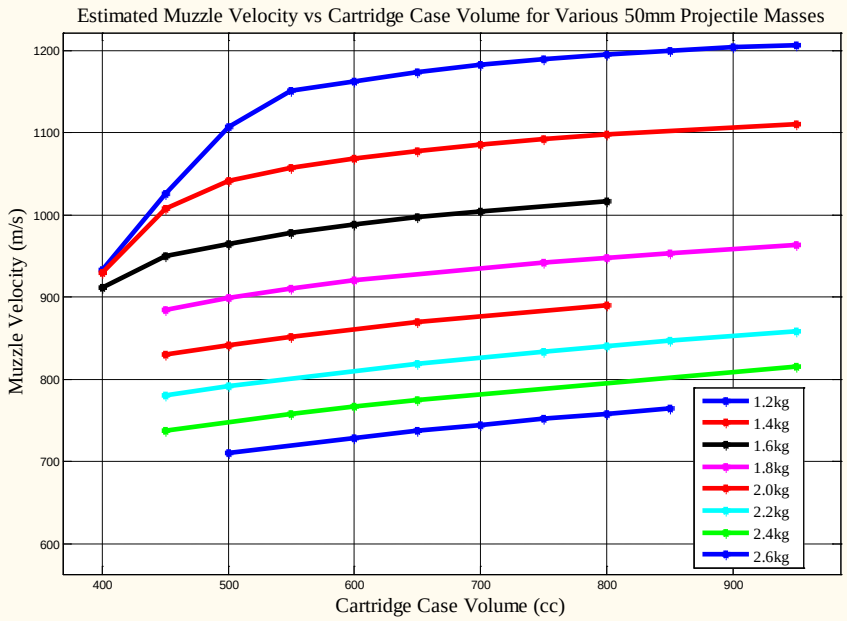
EAPS Caliber Trade Study Evaluation Steps



- Due to the dynamic interactions of intercept and numerous threats, the caliber trade study used extensive modeling and simulation to understand relationships.
- Results indicate the following areas of key interest : antenna size and placement, chain gun ICD limits, divert limits, warhead velocity ratio, total liner mass, and fragment mass.

Subsystem: Propulsion Estimates

Chamber Volume Sizing (50mm)

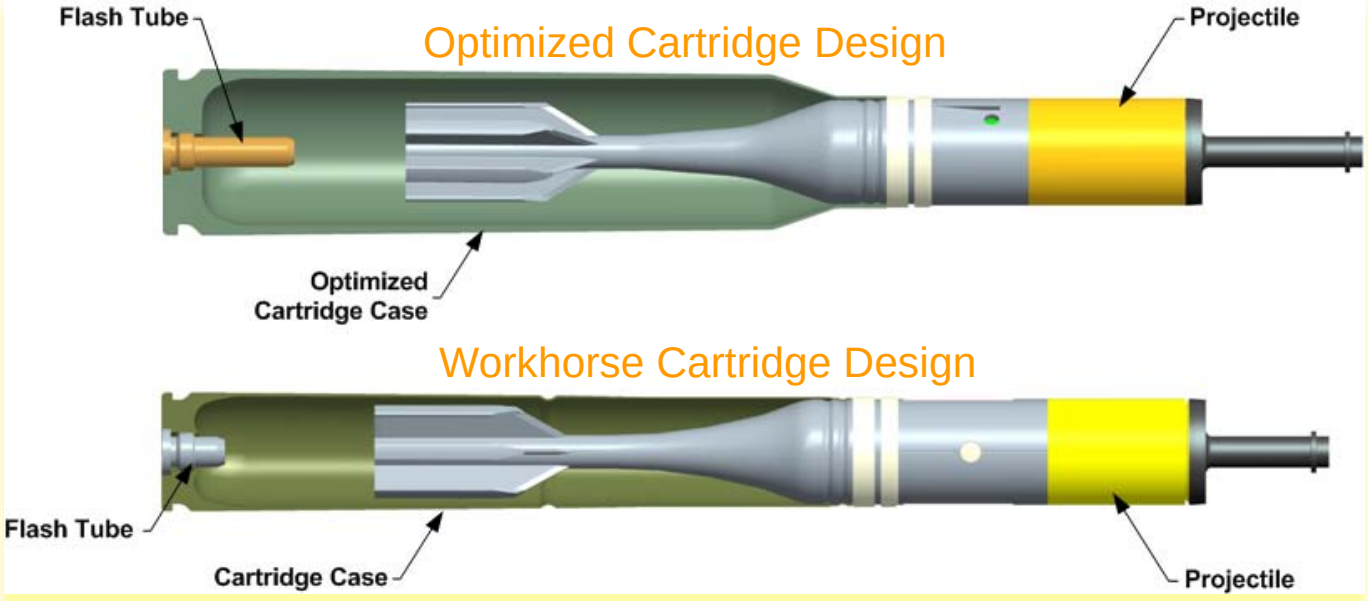


Estimated Maximum Velocity

	Caliber				
Mass	**50**	**55**	**60**	**65**	**70**
1.2	1225				
1.4	1140	1242			
1.6	1050	1174	1267		
1.8	959	1113	1194		
2	950	1047	1126	1220	
2.2	902	1004	1064	1161	
2.4	861	961	1013	1107	
2.6	824	907	980	1054	
2.8		862	928	1004	
3			867	971	
3.2			865	935	
3.4				908	
3.6				865	

- Assumed an unconstrained chamber volume and generated muzzle velocity versus chamber volume curves
  - Performed for each caliber and mass combination.
  - Sufficient volume was provided to ensure diminishing returns was achieved.
- Used projectile mass statistics from ProEngineer models to establish mass values for each caliber.
- Muzzle velocity estimates were generated based on the chamber volume sizing.
  - Peak velocity was recorded in the table and is considered feasible for an optimized propellant.

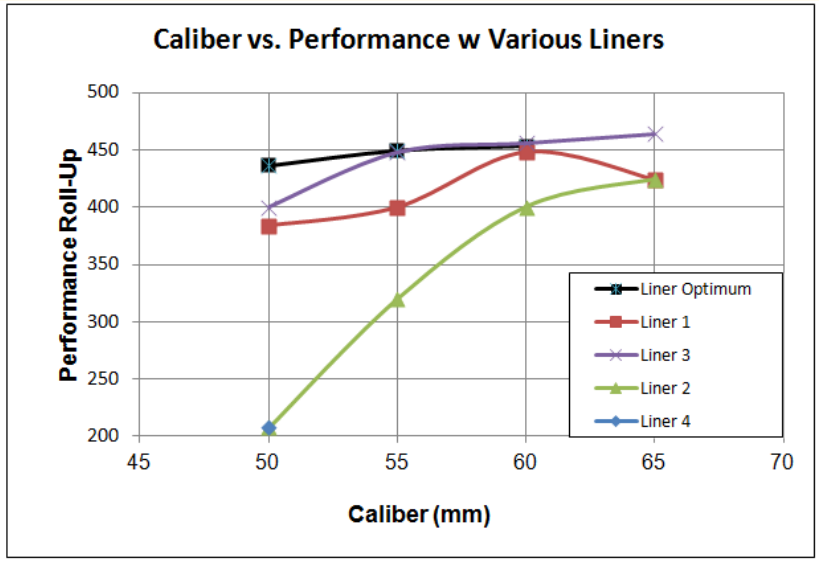
Baseline Design Established



– Final cartridge case sizing based on gun constraints for length, diameter, etc.

– Optimized liner increased performance significantly in the 50mm.

– Larger calibers have increased logistics burden that offset performance gains.



Summary

- EAPS Interfermetric Radar Fabrication Nearly Complete.
  - Initial Tests by 4th Qtr FY12.
- System Optimization Study Completed
  - Lethality Assessment Underway to verify warhead performance.
- Optimized Interceptor Design Completed.
  - Increased Muzzle Velocity, Reduced Drag, Higher Lethality.
- Optimized EAPS Auto Cannon Development Initiated.
  - Still 50mm But Increased Cartridge Volume.