



U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND – AVIATION & MISSILE CENTER

Science and Technology Overview

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CCDC VISION AND MISSION



VISION

To be the scientific and technological foundation of the Future Force Modernization Enterprise through world-leading research, development, engineering and analysis.

MISSION

To provide the research, engineering, and analytical expertise to deliver capabilities that enable the Army to deter and, when necessary, decisively defeat any adversary now and in the future.





CCDC ORGANIZATION



Headquarters U.S. Army Combat Capabilities Development Command Aberdeen Proving Ground, MD



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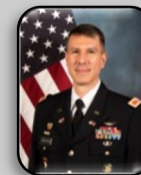


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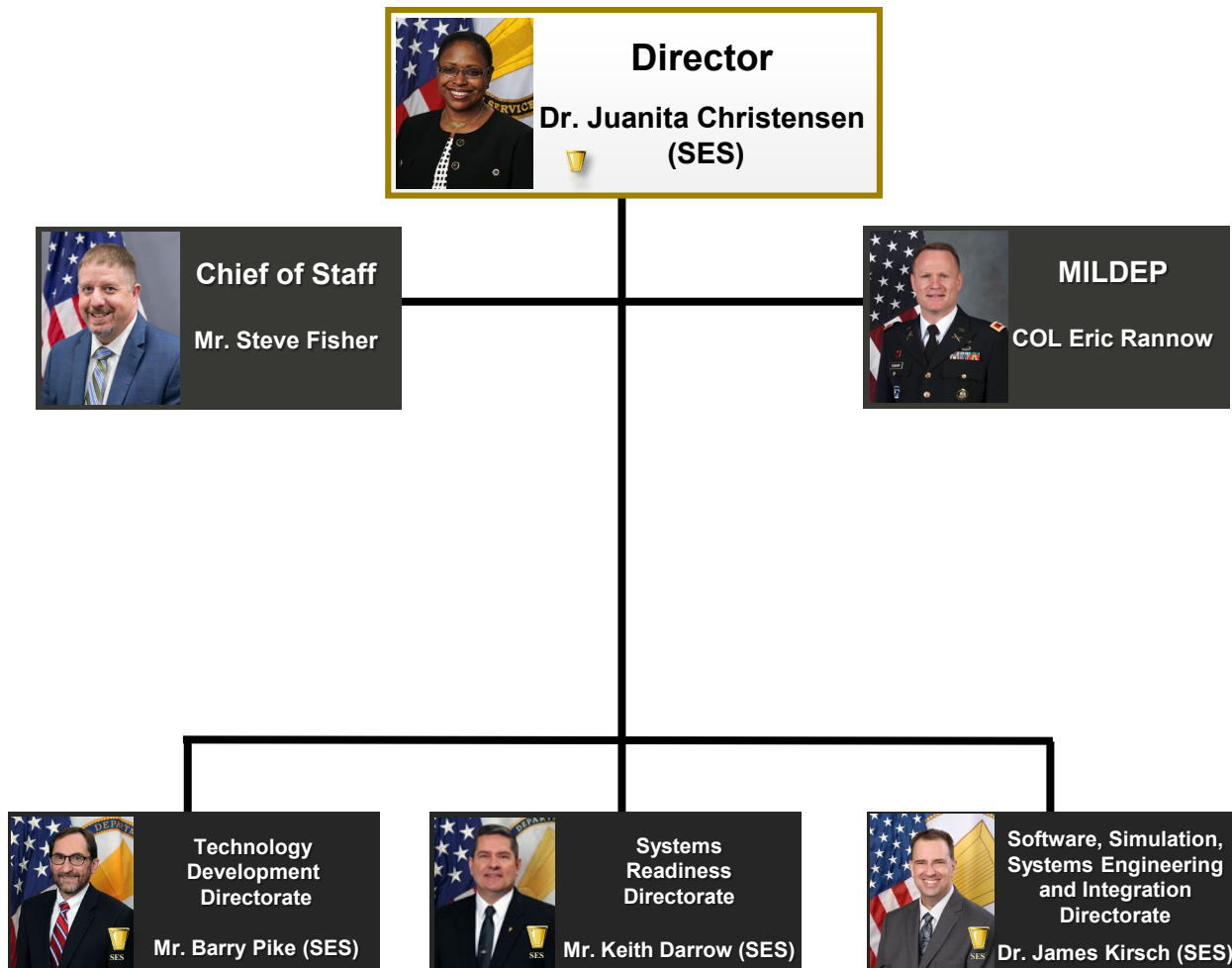
CCDC Pacific



**COL
Daryl Harger**



OUR LEADERSHIP



Scientific & Technical Positions (STs)

	Group Leader / Flight Control Technology Dr. Mark Tischler
	Optical Sciences Dr. Henry Everitt
	Aviation Advanced Design Vacant
	Radio Frequency Sensors Dr. Brian Smith
	Protective Technologies Dr. Donna Joyce



OUR MISSION



Deliver collaborative and innovative aviation and missile capabilities for responsive and cost-effective research, development and life cycle engineering solutions.



BY THE NUMBERS



12,054
FY19 Strength



3,036
Civilian

23
Military

~8,995
Contractor

Core Competencies

Technical Domain:

- Active and Passive Air Defense Sensor Technology (S&T)
- Aerial Autonomy
- Aerospace and Aerodynamics
- Capabilities Engineering
- Materials and Structures
- Fuzing, Guidance, Controls and Seekers
- Propulsion, Explosives, Energetics, Warheads

Capabilities Engineering:

- Software Engineering
- Weapons Assurance
- Modeling and Sim Design, Dev, VV&A
- Configuration Management
- Engineering Prototype Design and Dev
- Maintenance, Life Cycle Cost Reduction, and Logistics Engineering
- Manufacturing Tech and Production Support
- Multidiscipline Acquisition and Project Engineering
- Quality Engineering and Management
- Reliability, Availability, and Maintainability
- Sustainment, Industrial Base, and Obsolescence
- Systems Engineering, Integration, and Interoperability
- Test and Evaluation
- Air Defense Radar (Reimbursable)
- Airworthiness

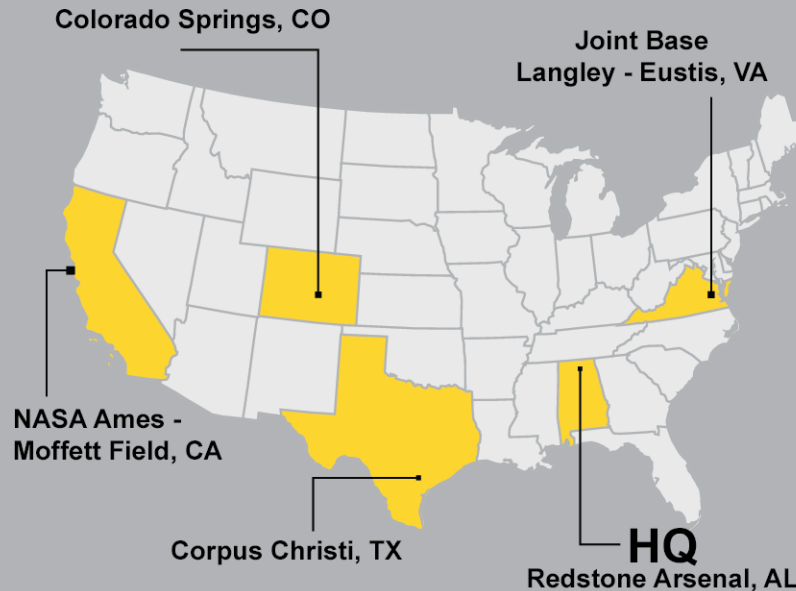
FY19 Funding
\$3.8B

6%
Aviation S&T

7%
Missile S&T

59%
Army

28%
Other





OUR PRIORITIES



#1: People

People are the Army's greatest strength and its most important weapon system.



#2: Readiness

The Army must be ready to defeat any adversary, anywhere, whenever called upon, under any condition.



#3: Modernization

The Army must modernize to remain lethal and ready to fight tomorrow, against increasingly capable adversaries and near-peer competitors.



#4: Reform

The Army will improve the way we do business, including how we implement our top priorities, to make the Army more lethal, capable, and efficient.



S&T PRIORITIES ALIGNED WITH THE ARMY MODERNIZATION STRATEGY



**LONG RANGE
PRECISION FIRES**



**NEXT GENERATION
COMBAT VEHICLE**



**FUTURE
VERTICAL LIFT**



**ARMY
NETWORK**



**AIR & MISSILE
DEFENSE**



**SOLDIER
LETHALITY**

Supporting Army and Joint Readiness now and in the Future MDO Environment

RESEARCH ISO FUTURE FORCE

Driving the discoveries and innovations which will be critical to realizing new capabilities for the Army of 2030 and beyond.

ANALYSIS

Conducting objective experimentation and systems analysis to support the equipping and sustaining of our Warfighters.

ENGINEERING

Providing lifecycle engineering expertise to support fleet development and readiness across warfighting battlefield operating systems.



AVIATION S&T ALIGNMENT TO ARMY MODERNIZATION PRIORITIES



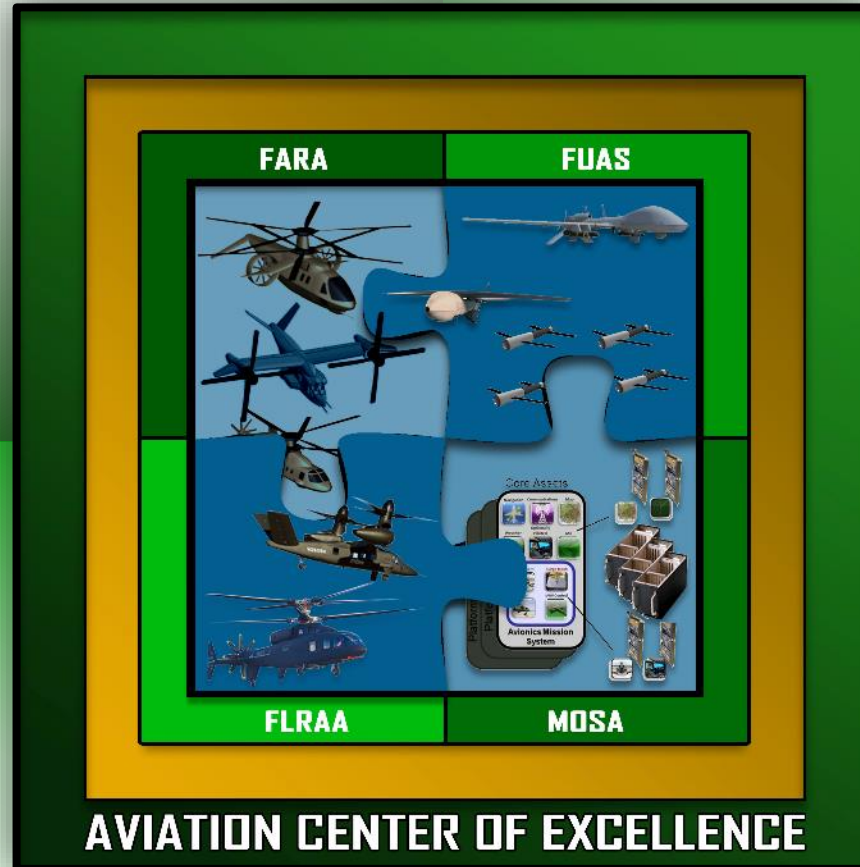
FVL Modernization Lines of Effort

FUTURE ATTACK RECONNAISSANCE AIRCRAFT

Critical combat system needed to prevail in future wars by enabling Army Aviation to achieve a "leap-ahead" in lethality, survivability, and reach to find, fix, and finish our pacing threats.

FUTURE LONG RANGE ASSAULT AIRCRAFT

Essential to exploit the windows of opportunity created by FARA and advanced teaming with UAS/ALE with its increased speed and reach providing significantly more lethal and effective Air Assault and MEDEVAC capabilities on the future battlefield.



FUTURE UNMANNED AIRCRAFT SYSTEMS

Advanced teaming FVL with next generation UAS delivering lethal and non-lethal air launched effects enables cross-domain fires to penetrate and dis-integrate enemy A2AD systems and exploit expanded maneuver to overmatch peer adversaries.

MODULAR OPEN SYSTEMS APPROACH

The government defined Modular Open System Approach will establish the digital backbone of FVL aircraft allowing for rapid and affordable integration of innovative avionics and mission equipment technologies into our platforms.

LETHALITY

REACH

PROTECTION



MISSILE S&T ALIGNMENT TO ARMY MODERNIZATION PRIORITIES



Army Modernization Priorities

LONG RANGE PRECISION FIRES

Technologies for the development, integration and delivery of long range fires at the tactical, operational, and strategic echelons to restore overmatch, improve deterrence, and disrupt A2AD on a complex, contested and expanded battlefield.

AIR & MISSILE DEFENSE

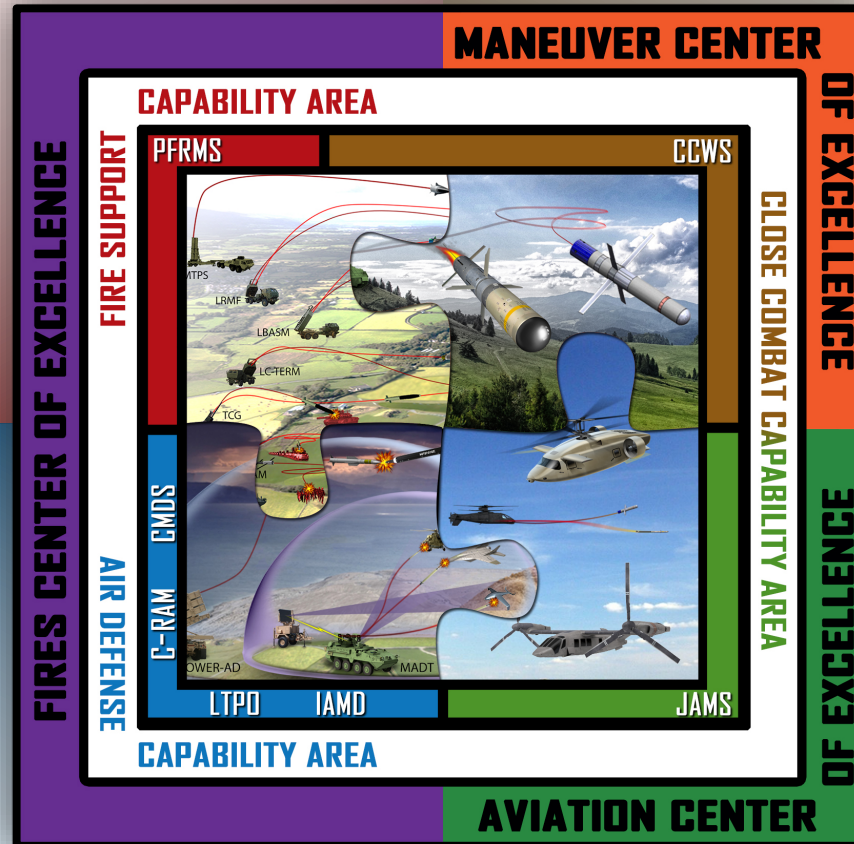
Technologies for the development of mobile air defense systems that reduce the cost curve of missile defense, restore overmatch, survive volley-fire attacks, and operate within sophisticated A2AD and contested domains.

NEXT GENERATION COMBAT VEHICLE

Technologies for active protection systems and enhanced lethal effects that will increase our ability to survive and win in the complex and densely urbanized terrain of an intensely lethal and distributed battlefield where all domains are continually contested.

FUTURE VERTICAL LIFT

Technologies for the development, integration, and delivery of aviation launched air-to-ground and air-to-air missile systems to restore overmatch within sophisticated A2AD and contested domains.



ENGAGE FIRST

EXPAND THE DOME

ON THE MOVE



CCDC AvMC MISSILE S&T ALIGNMENT TO ARMY MODERNIZATION PRIORITIES



Army Modernization Priorities

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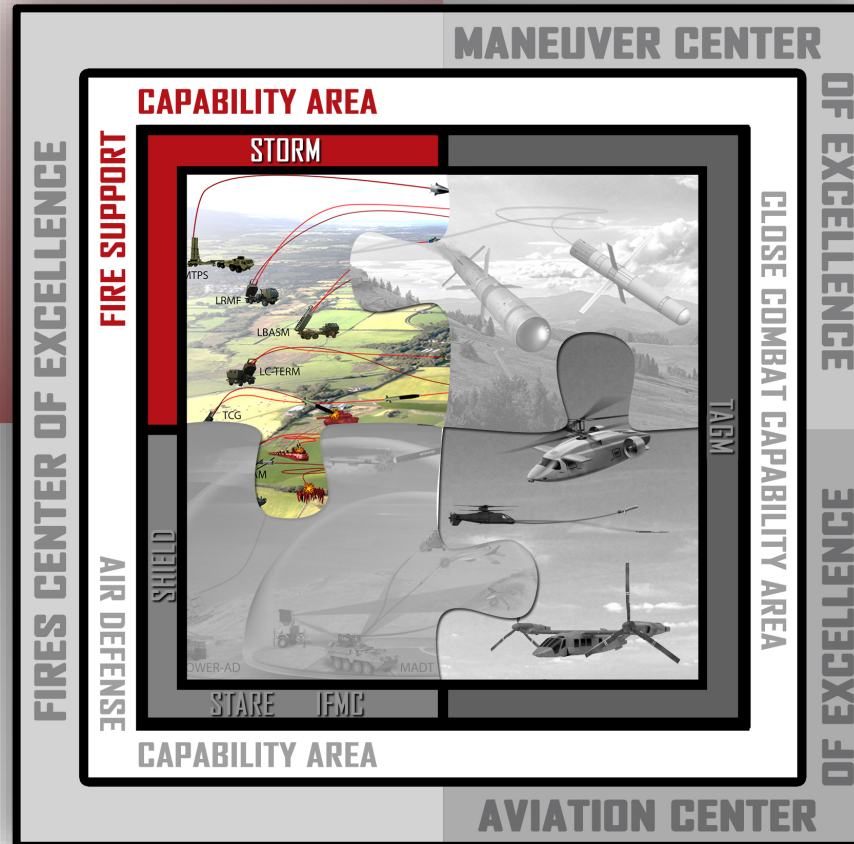
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ENGAGE FIRST

EXPAND THE DOME

ON THE MOVE



LONG RANGE PRECISION FIRES (LRPF) MODERNIZATION PRIORITY



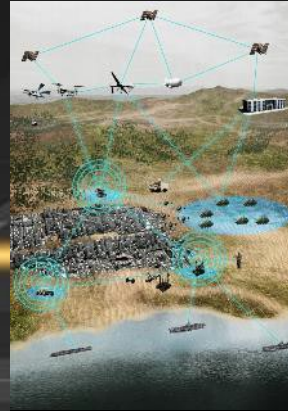
**LONG RANGE
PRECISION FIRES**



**NEXT GENERATION
COMBAT VEHICLE**



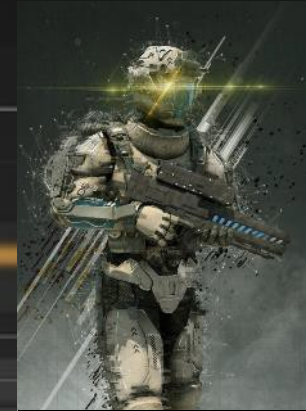
**FUTURE
VERTICAL LIFT**



**ARMY
NETWORK**



**AIR & MISSILE
DEFENSE**



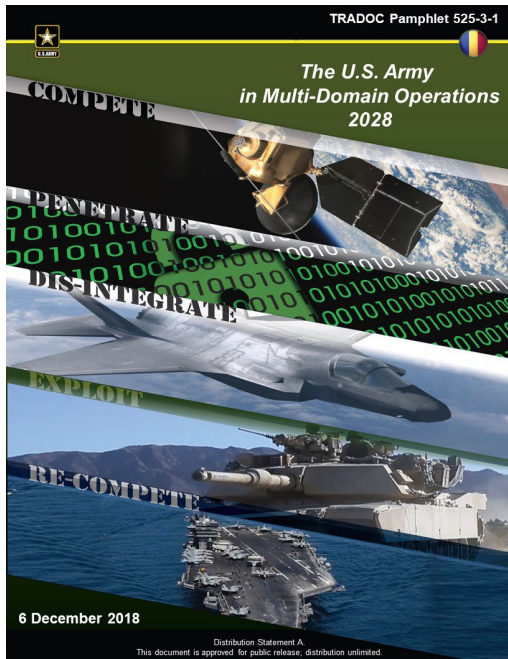
**SOLDIER
LETHALITY**

Supporting Army and Joint Readiness now and in the Future Multi-Domain Operation (MDO) Environment

Long range precision fires enable multi-domain forces to penetrate and neutralize enemy A2/AD capabilities while ensuring military overmatch at every echelon.

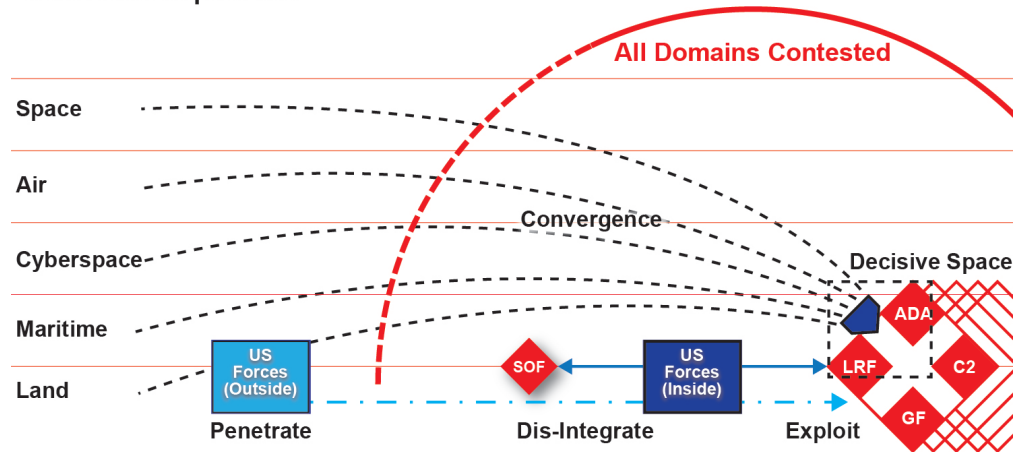


MULTI-DOMAIN OPERATIONS (MDO) SOLUTION SPACE



The Army MDO Strategy is the forcing function for all LRPF modernization efforts and the focus for Fire Support Capability Area S&T investments

Joint Force Capabilities



Multi-Layered Stand-off

Competition

- Create political separation
- Diplomatic means
 - Economic levers
 - Unconventional warfare
 - Information operations
 - Conventional forces

Armed Conflict

- Separate the Joint Force in time, space and function
- Long-range fires
 - Unconventional warfare
 - Ground-based air defense systems
 - Electronic warfare, space, and cyber

xxxx Compete

TA
FA

- Enable defeat of information and unconventional warfare
- Conduct intelligence & counter adversary reconnaissance
- Demonstrate credible deterrent

Diplomatic
Economic

Whole of Government

xxxx Penetrate

FA

- Penetrate and begin neutralizing enemy long-range air defense
- Neutralize and dis-integrate key elements of long-range fires
- Contest enemy maneuver forces
- Maneuver from operational and strategic distances

Information Warfare, Unconventional Warfare

National- & District-Level Forces

IRBMs/SRBMs, Cruise Missiles, Cyber, Long-Range SAMs

xxx Dis-Integrate

A

- Complete dis-integration of long-range air defense
- Exploit dis-integration of long-range fires
- Neutralize mid-range fires
- Conduct independent operational maneuver
- Conduct deception

SRBMs, Mid-Range SAMs, Long-Range Multiple Rocket Launchers

Conventional Forces

Multiple Rocket Launchers, Cannon Artillery

xx Exploit

A
B

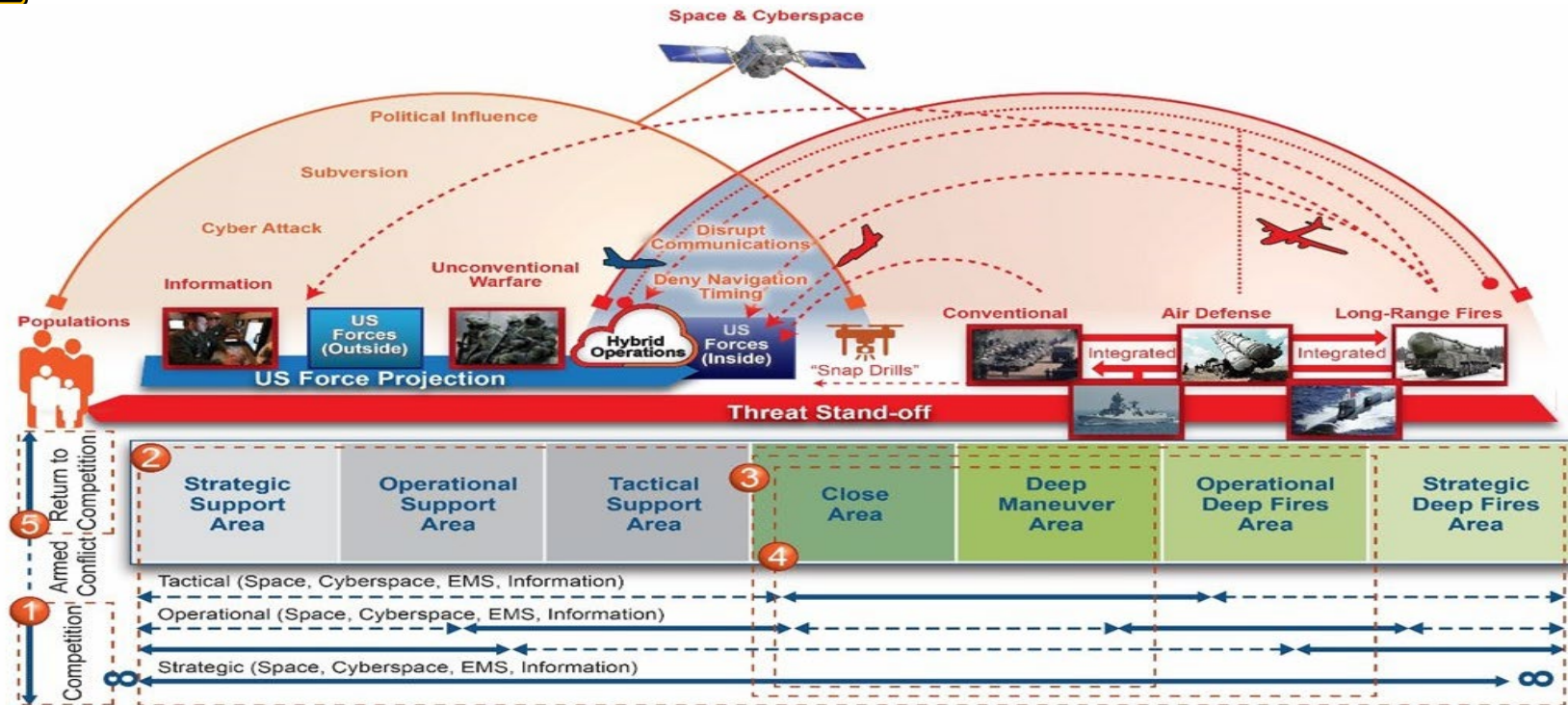
- Exploit dis-integration of long-range fires and air defense
- Dis-integrate medium-range fires
- Maneuver to positions of advantage
- Isolate and defeat enemy land forces

Maneuver, Short-Range Air Defense, Electronic Warfare, Counter-PNT, Cyber

Long Range Fires is Critical Element of Penetrate, Dis-Integrate, and Exploit



LRPF IN MULTI-DOMAIN OPERATIONS (MDO)



HOW DOES LRPF ENABLE THE JOINT FORCE TO...

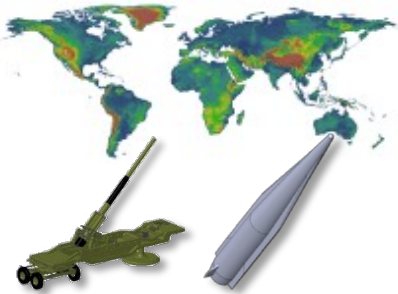
- 1 Compete to enable the defeat of an adversary's operations to destabilize the region, deter the escalation, and enable a rapid transition to armed conflict?
 - ✓ Strategic Fires forward deployed that place enemy forces at risk and can quickly respond to emerging threats.
- 2 Penetrate enemy A2/AD to enable strategic and operational maneuver?
 - ✓ Strategic and fires that can penetrate adversaries layered stand off to create windows of opportunity for exploitation by the Joint Force.
- 3 Dis-integrate enemy A2/AD systems in the Deep Areas to enable operational and tactical maneuver?
 - ✓ Operational Fires that attack and dis-integrate critical enemy A2/AD systems.
- 4 Exploit freedom of maneuver to achieve operational and strategic objectives in the Close and Deep Maneuver Areas?
 - ✓ Tactical Fires enable cross-domain maneuver.
- 5 Re-compete to consolidate gains and produce sustainable outcomes, set conditions for long-term deterrence, and adapt to the new security environment?



LRPF CROSS FUNCTIONAL TEAM (CFT) SCOPE AND OBJECTIVES



STRATEGIC FIRES



WHAT: A surface to surface strategic fires capability consisting of two complementary systems: a long range cannon system and a hypersonic weapon.

WHY: Penetrate and dis-integrate adversary A2/AD complexes to open windows of opportunity for exploitation by the Joint Force.

HOW: Science & Technology demonstrations built on extensive modeling, engineering and experimentation, followed by system procurement and fielding in the 2023-2025 timeframe..

OPERATIONAL FIRES: PRECISION STRIKE MISSILE



WHAT: The Precision Strike Missile (PrSM) is a long range missile fired from existing launcher platforms with greater range, lethality and survivability at a lower cost than ATACMS.

WHY: Neutralize enemy IADS and long range artillery in order to enable cross domain maneuver.

HOW: Accelerate program of record to field a base missile capability with >500km range in FY23 followed by technology spirals for multi-domain targets, enhanced lethality, and extended range.

TACTICAL FIRES: EXTENDED RANGE CANNON ARTILLERY



WHAT: Extended range 155mm self-propelled artillery system with greater lethality, precision, and survivability. ERCA capability includes cannon, supercharge propellant, course correcting fuse, and ammunition upgrades.

WHY: Neutralize enemy high payoff systems IOT achieve combined arms overmatch at the tactical level.

HOW: Field systems with 58 caliber cannon tube, sliding block breech and auto-loader along with required improved propellant (supercharge) and new rocket assisted projectile capable of 70km range. Begin fielding in FY23.



STRATEGIC MISSILE ADVANCED TECHNOLOGY (SMAT) PROJECT OVERVIEW



PURPOSE

- Science and Technology effort for the development and demonstration of technologies/component upgrades for insertion into Block 3 Design for LRHW C-HGB. Aerostructures/thermal protection technology to improve performance/producibility and decrease weight and production cost; GNC technology to enhance performance to mitigate effects of GPS jamming/spoofing and engage re-located targets; and kill Chain development/integration into existing C2I architecture.



IMPORTANCE TO THE ARMY

- Rapid insertion for enhancements to the common hypersonic glide body (CHGB) for the Long Range Hypersonic Weapon (LRHW).
- Ensure enduring military superiority, impose unexpected costs or effects on adversaries, and rapidly transition disruptive/adaptable technology.
- Enhance performance, survivability, and manufacturability and reduce cost of hypersonic glide bodies.

OUTLOOK FOR THE FUTURE

- Technology focus is advanced aero-structures for improved performance, cost and manufacturing throughput; dynamic kill chain integration; performance in GPS denied environments; and advanced thermal management technology.
- Primary deliverables will be: component demonstrations of prototype hardware/software on a prototype Block 3 design of the LRHW C-HGB, and; b) respective component design documentation packages, including performance requirements, hardware/software design and interface documentation, and prototype hardware/software and test data.

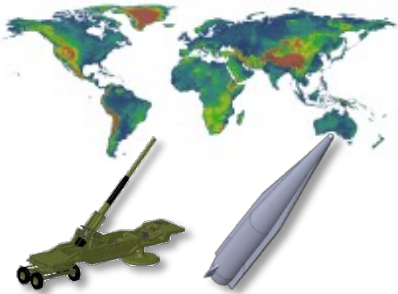


LRPF CROSS FUNCTIONAL TEAM (CFT)

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PrSM MODERNIZATION STRATEGY: PLANNED SPIRAL TECHNOLOGY INSERTION



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PrSM TECHNOLOGY INSERTION



MDO Capability in A2/AD Environments

- Multi-mode seeker for engaging maritime and land targets
- Precision target engagement in complex A2/AD environments



Enhanced Lethality Payloads

- Dispensable autonomous/cooperative hunter/killer payloads for engaging moved, moving, dispersed and poorly located targets



Extended Range Lethality & Survivability

- Greatly extend range of PrSM in complex A2/AD and denied environments

PLATFORM IMPROVEMENTS

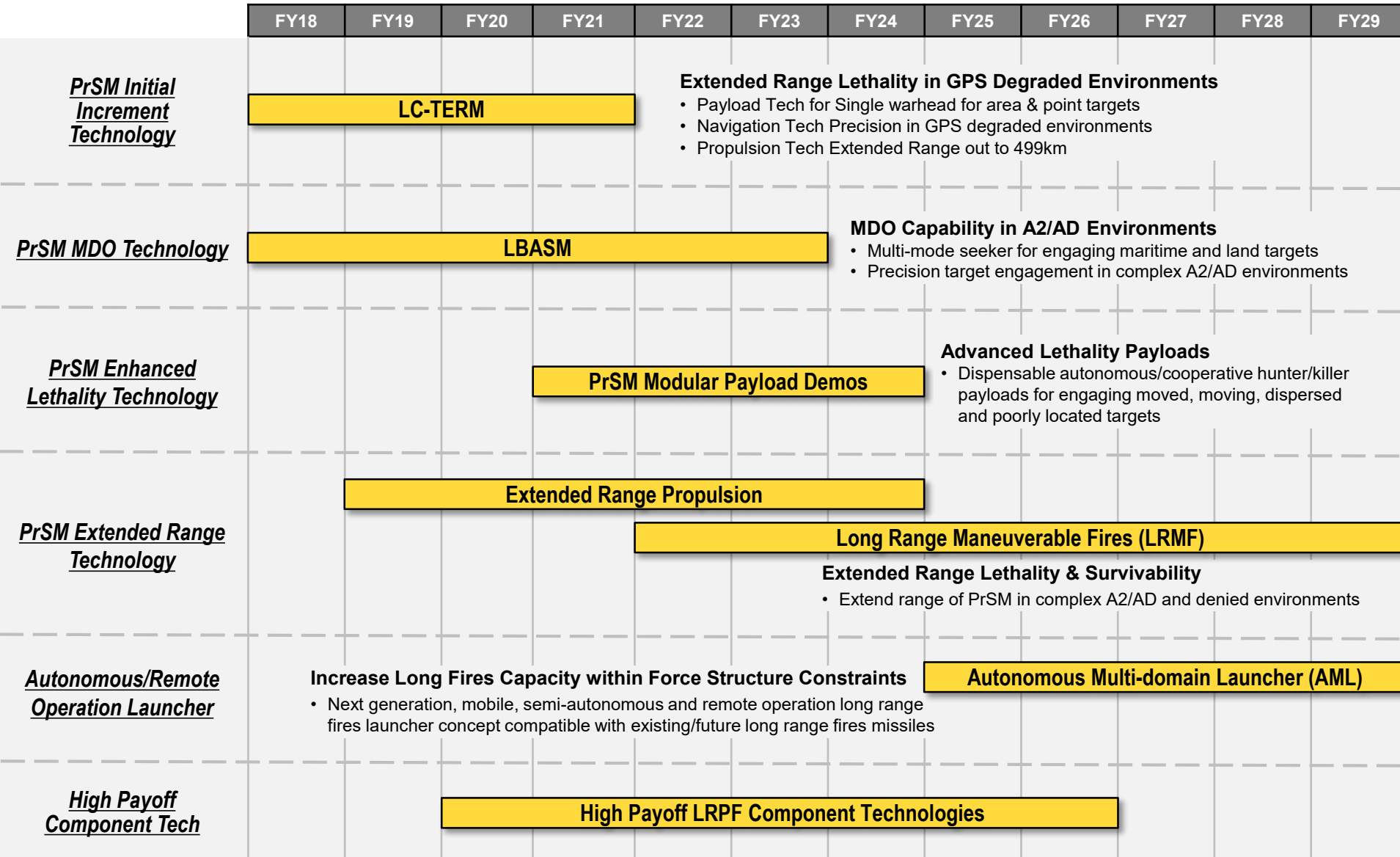


Unmanned LRP Rocket & Missile Launcher

- Unmanned, highly mobile, C-130 transportable, cab-less, HIMARS chassis based, unmanned LRP launcher.



CCDC AvMC LRPF OPERATIONAL FIRES MISSILE S&T ROADMAP





LOW-COST TACTICAL EXTENDED RANGE MISSILE (LC-TERM) S&T PROJECT



PURPOSE

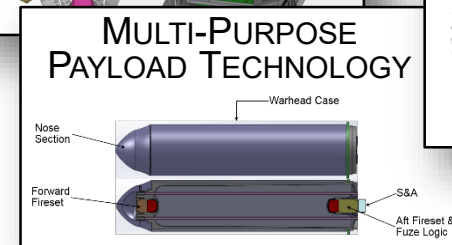
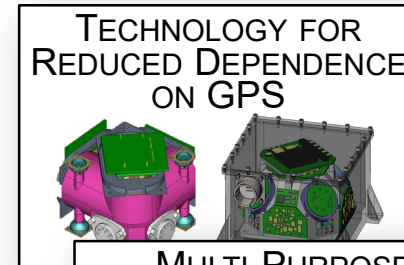
- Develop and demonstrate advanced navigation, propulsion, and payload components that reduce dependence on GPS, increase range/area coverage, and provide selectable effects against area and point targets

IMPORTANCE TO THE ARMY

- Propulsion technologies (light weight/high strength materials, design techniques, and improved processing) and a fully integrated propulsion system that enables target engagement out to 499km
- Navigation component technologies and integration techniques and a fully integrated navigation system that reduces dependence on GPS for precision effects

OUTLOOK FOR THE FUTURE

- Demonstrate and transition payload technologies that enable selectable engagement of both area and point target in a single warhead
- Provide surface-to-surface fires overmatch through: extended range; precision in GPS denied environment; selectable area and point effects mitigating loss of capability due to DoD Cluster Munitions Policy





LAND-BASED ANTI-SHIP MISSILE (LBASM) S&T PROJECT



PURPOSE

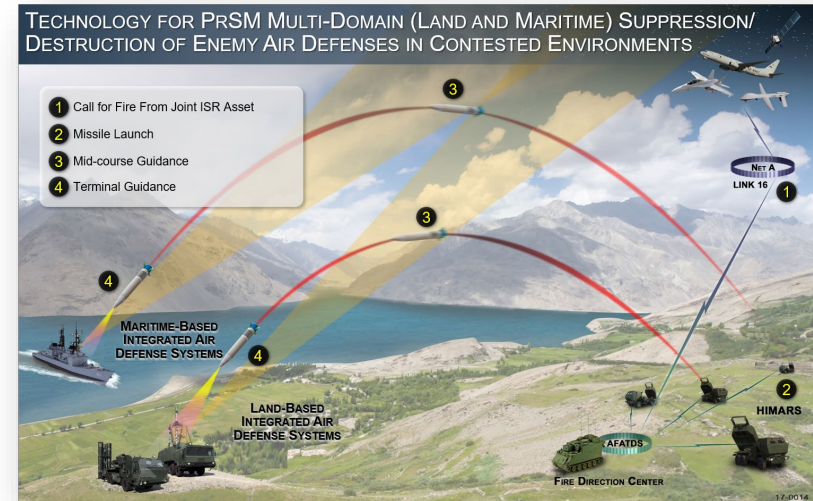
- Demonstrate advanced sensor and lethal payload technologies that enable HIMARS & MLRS rocket/missile artillery systems to destroy enemy air defenses in the land and the maritime domains.

IMPORTANCE TO THE ARMY

- Development and demonstration of appropriate sensor and payload component technologies for engaging and defeating air defense artillery systems.
- Integration of these component technologies into prototype missile hardware and demonstration of this hardware in a relevant flight environment.
- Provides evidence for the feasibility of adapting existing Army and Marine Corps GMLRS and HIMARS systems for offensive anti-ship warfare.

OUTLOOK FOR THE FUTURE

- Demonstrate and transition technologies to PrSM Program of Record that provide capability to deny the establishment of threat A2/AD capabilities across multiple domains and create cross-domain windows of advantage that enable Joint Force freedom of action by defeating advanced enemy air defense capabilities in both the land and maritime domains.





PrSM MODULAR PAYLOADS S&T PROJECT



PURPOSE

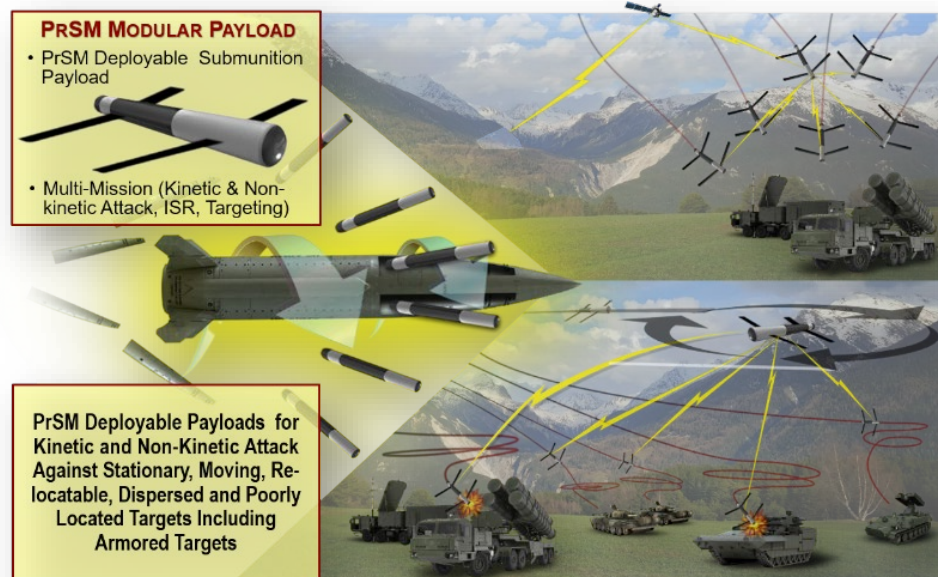
- Development and demonstrate autonomous payloads capable of collaboratively detecting, targeting, and striking high payoff targets that are moving, have moved, poorly located, or dispersed.

IMPORTANCE TO THE ARMY

- Hardened deployable payload airframe compatible with long range fires delivery systems such as Precision Strike Missile (PrSM).
- Dispense mechanization capable of dispensing deployable autonomous payloads from long range fires systems such as PrSM.
- Autonomous payloads capable of collaboratively detecting, targeting, and striking high payoff targets that are moving, have moved, poorly located, or dispersed.
- Integration into and flight demonstration from PrSM.

OUTLOOK FOR THE FUTURE

- Demonstration and transition technologies that enable Army long range fires to converge with other combined joint multi-domain capabilities to penetrate and dis-integrate enemy A2/AD systems to enable Joint Force freedom of maneuver.





EXTENDED RANGE PROPULSION (ERP) TECHNOLOGY S&T PROJECT



PURPOSE

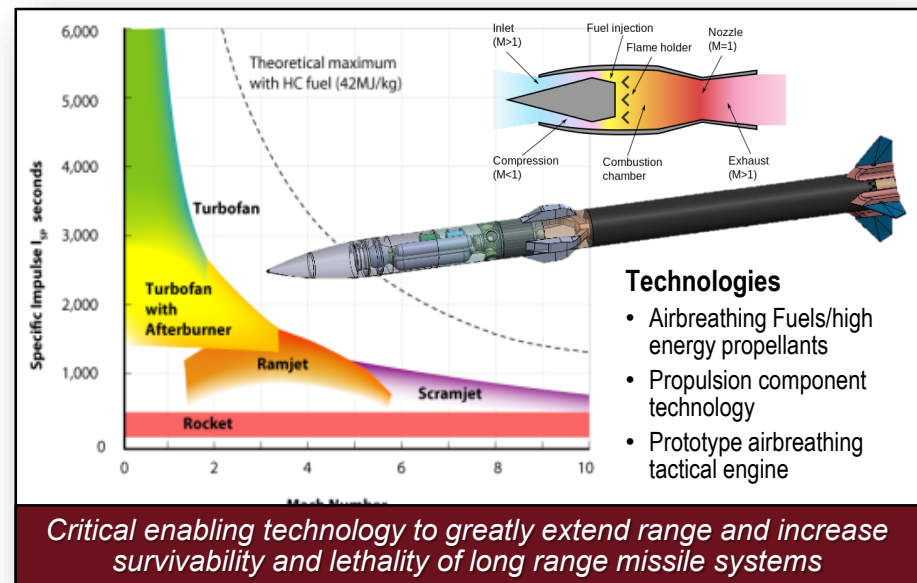
- Development of low cost integral air-breathing solid ramjet propulsion technology that enables significant range extension and/or block speed improvement for long range surface-to-surface fires and surface-to-air and air-to-air air defense applications

IMPORTANCE TO THE ARMY

- Mature, tailorable, and commercially viable solid ramjet fuels
- Material solutions for thermal management, mature material interfaces, and motor component technologies
- Prototype air-breathing engine in relevant configuration for future army missions

OUTLOOK FOR THE FUTURE

- Demonstrate and transition enabling technology to deny the establishment of threat A2/AD capabilities across multiple domains and create cross-domain windows of advantage that enable Joint Force freedom of action through surface-to-surface missiles with ranges well in excess of 500 kilometers capable of striking targets both on land and at sea





AUTONOMOUS MULTI-DOMAIN LAUNCHER (AML) S&T PROJECT



PURPOSE

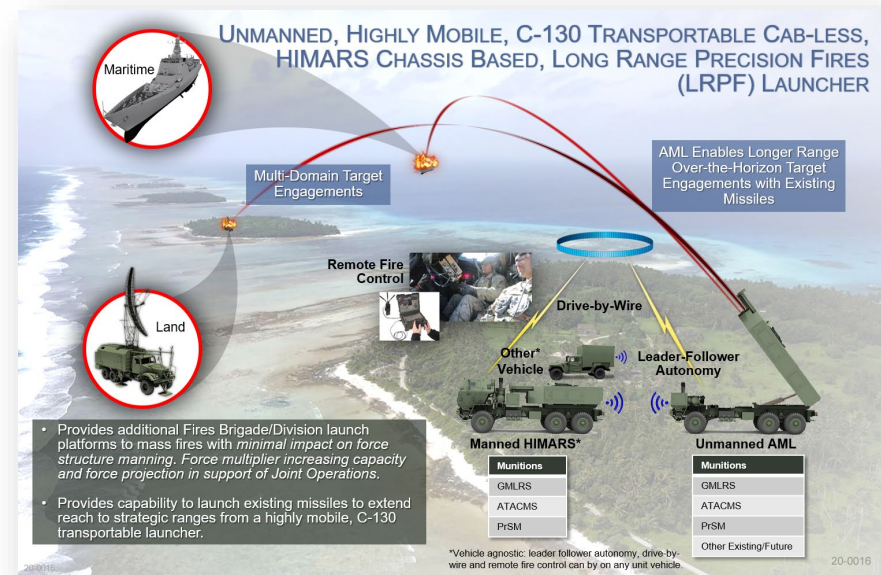
- Develop and demonstrate an unmanned, highly mobile, C-130 transportable cab-less HIMARS chassis based, Long Range Precision Fires (LRPF) launcher.

IMPORTANCE TO THE ARMY

- Unmanned operation includes leader-follower autonomy, drive-by-wire, and remote launcher turret and fire control operation.
- Capable of handling/launching longer munitions while remaining compatible with the current MLRS Family of Munitions (MFOM).

OUTLOOK FOR THE FUTURE

- Provides additional Fires Brigade/Division launch platforms to mass fires with minimal impact on force structure manning. Force multiplier increasing capacity and force projection in support of Joint Operations.
- Provides capability to launch other existing and future missiles to extend reach to strategic ranges from a highly mobile, C-130 transportable launcher.



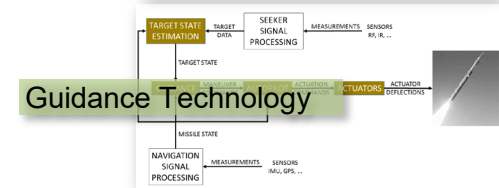
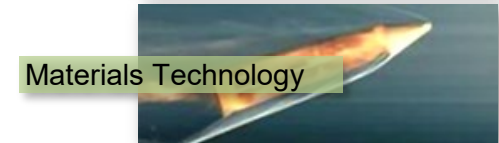
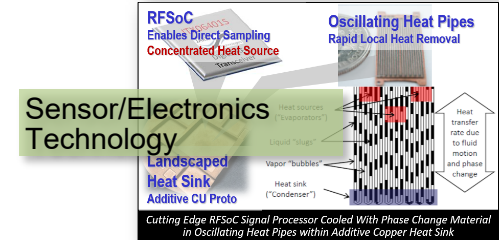
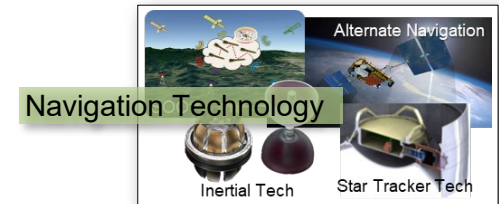


HIGH PAYOFF LRPf COMPONENT TECHNOLOGIES



TECHNOLOGY FOCUS / INVESTMENTS

- **Navigation technology that enables accurate guidance in heavily contested environments such as full GPS denial**
 - Advanced inertial measurement technology (DARPA and AF leverage)
 - Resilient collaborative positioning using signals of opportunity & software defined radio
 - Star Tracker Technology
 - Alternate navigation technology
- **Sensors and electronics technology for precision strike, miniaturization, and thermal management**
 - Image stabilization technology for strap-down sensors
 - Advanced RF sensor thermal management technology
 - All solid state high current thermal battery technology
- **Materials technology for reduced size, weight, cost and extended range**
 - High temperature motor case insulation technology
 - Advanced optimization analysis/design techniques for high temperature materials
- **Guidance and control technology for improved accuracy**
 - Parallelized particle filter target state estimation technology
 - Long range secure missile datalink architecture assessment/development
- **Survivability and vulnerability assessment technology**
 - Products to assess and enhance survivability LRPf systems designed to penetrate and dis-integrate threat A2/AD capabilities (cooperative effort with ONI and MSIC)



Applied Research and Continuous Testing/Evaluation of High Risk/High Payoff LRPf Technologies



CCDC AvMC MISSILE S&T ALIGNMENT TO ARMY MODERNIZATION PRIORITIES



Army Modernization Priorities

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AIR & MISSILE DEFENSE

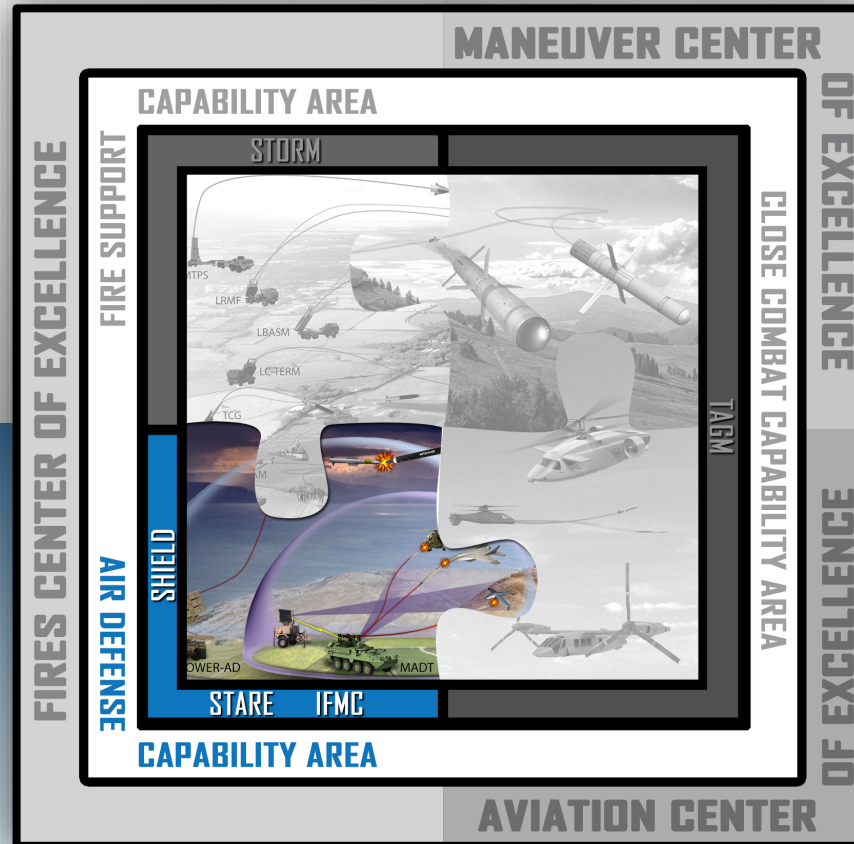
Technologies for the development of mobile air defense systems that reduce the cost curve of missile defense, restore overmatch, survive volley-fire attacks, and operate within sophisticated A2AD and contested domains.

NEXT GENERATION COMBAT VEHICLE

Technologies for active protection systems and enhanced lethal effects that will increase our ability to survive and win in the complex and densely urbanized terrain of an intensely lethal and distributed battlefield where all domains are continually contested.

FUTURE VERTICAL LIFT

Technologies for the development, integration, and delivery of aviation launched air-to-ground and air-to-air missile systems to restore overmatch within sophisticated A2AD and contested domains.



ENGAGE FIRST

EXPAND THE DOME

ON THE MOVE



AIR AND MISSILE DEFENSE (AMD) MODERNIZATION PRIORITY*



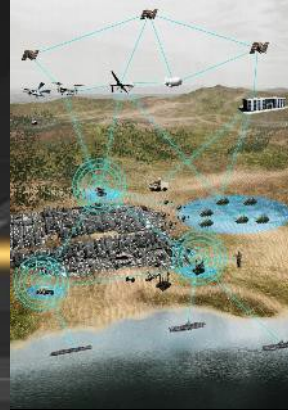
**LONG RANGE
PRECISION FIRES**



**NEXT GENERATION
COMBAT VEHICLE**



**FUTURE
VERTICAL LIFT**



**ARMY
NETWORK**



**AIR & MISSILE
DEFENSE**



**SOLDIER
LETHALITY**

Supporting Army and Joint Readiness now and in the Future Multi-Domain Operation (MDO) Environment

Air and Missile Defense will provide Combatant Commanders with a flexible, agile, and integrated AMD force capable of executing Multi-Domain Operations and defending the Homeland, regional joint and coalition forces, and critical assets in support of unified land operations.¹

* Army Air and Missile Defense (AMD) 2028 (March 2019)



AMD CFT MISSION AND SIGNATURE EFFORTS



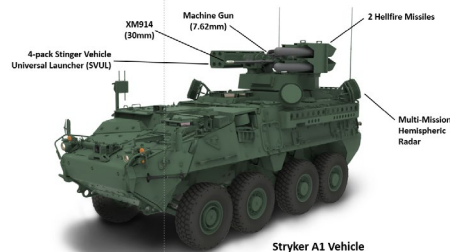
The AMD-CFT will **drive** the Army's modernization priorities by rapidly integrating and synchronizing the requirements development process, acquisition process and resources to deliver Air and Missile Defense capabilities to the warfighter faster and to inform the actions of Army Futures Command.



WHAT: Army Integrated Air and Missile Defense (AIAMD)

WHY: Provide common mission command across all Army AMD echelons, improve combat ID, flexibility in task organization, and improved joint integration.

HOW: AIAMD will replace multiple disparate C2 systems enabling improvement in coordinated engagements, positive control of sensors and weapons, friendly protection, and shared situational understanding.



WHAT: Maneuver - Short Range Air Defense (M-SHORAD)

WHY: Defend maneuvering forces against UAS, rotary and residual fixed wing threats.

HOW: The Army strategy is to deliver initial 4 battalions (144 systems) by FY23 with existing mix of guns, missiles, rockets, and onboard sensor -- integrated on a Stryker A1 platform. Follow on battalions will be equipped with enhanced effectors such as a laser or improved missile.



WHAT: Indirect Fire Protection Capability (IFPC)

WHY: Defend fixed and semi-fixed assets against sub-sonic cruise missiles and UAS threats with a residual capability against fixed and rotary wing aircraft.

HOW: Provide an interim "gap filler" capability with existing systems while simultaneously developing enduring capability.



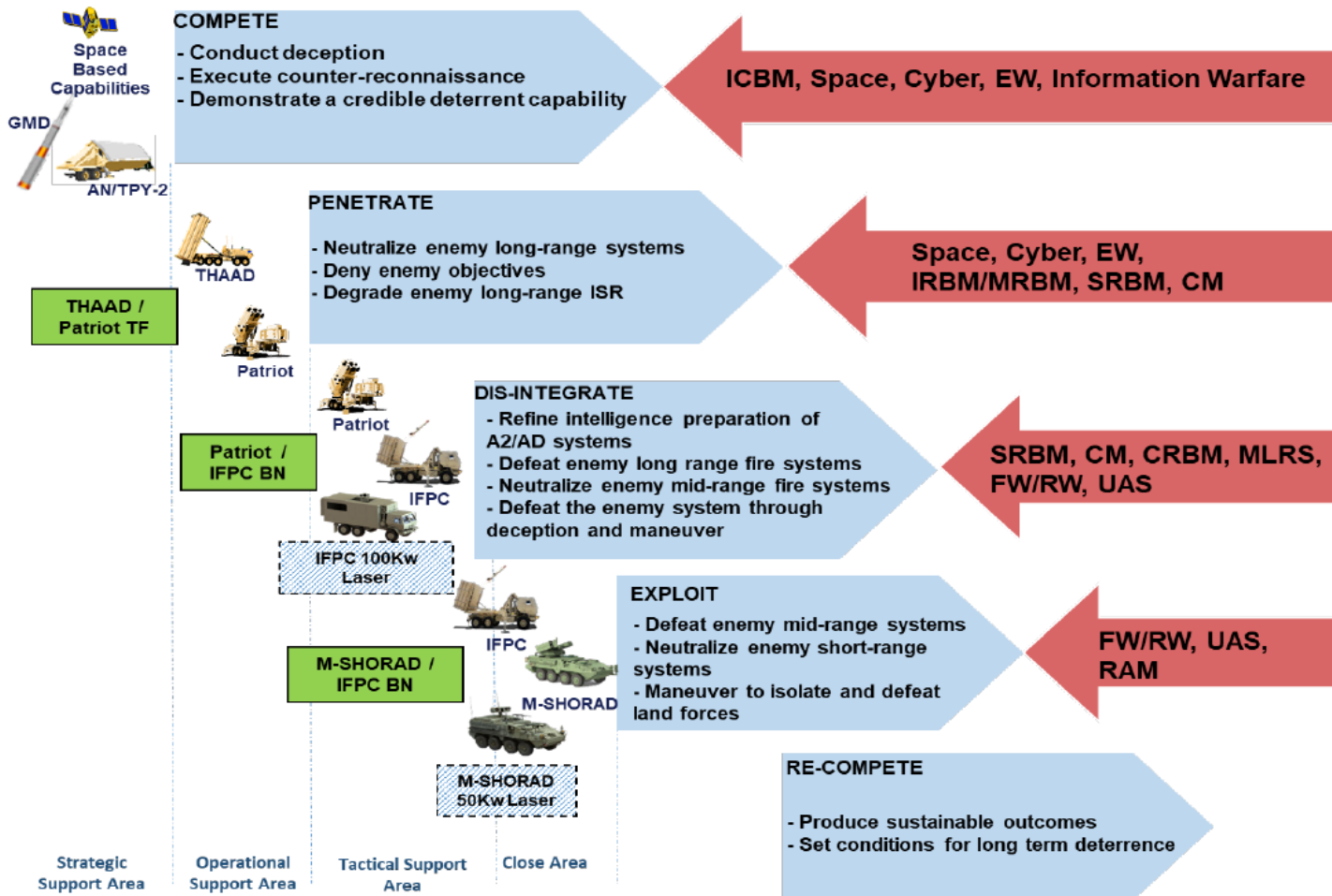
WHAT: Lower-Tier Air and Missile Defense Sensor (LTAMDS)

WHY: Deliver sensor capability to counter advanced threats and take full advantage of the Patriot Missile Segment Enhancement (MSE) capability.

HOW: The LTAMDS radar will replace the current Patriot radar and by design will be integrated into the AIAMD architecture to provide significant improvement over the current Patriot radar while enabling incremental growth.



AMD IN SUPPORT OF MULTI-DOMAIN OPERATIONS

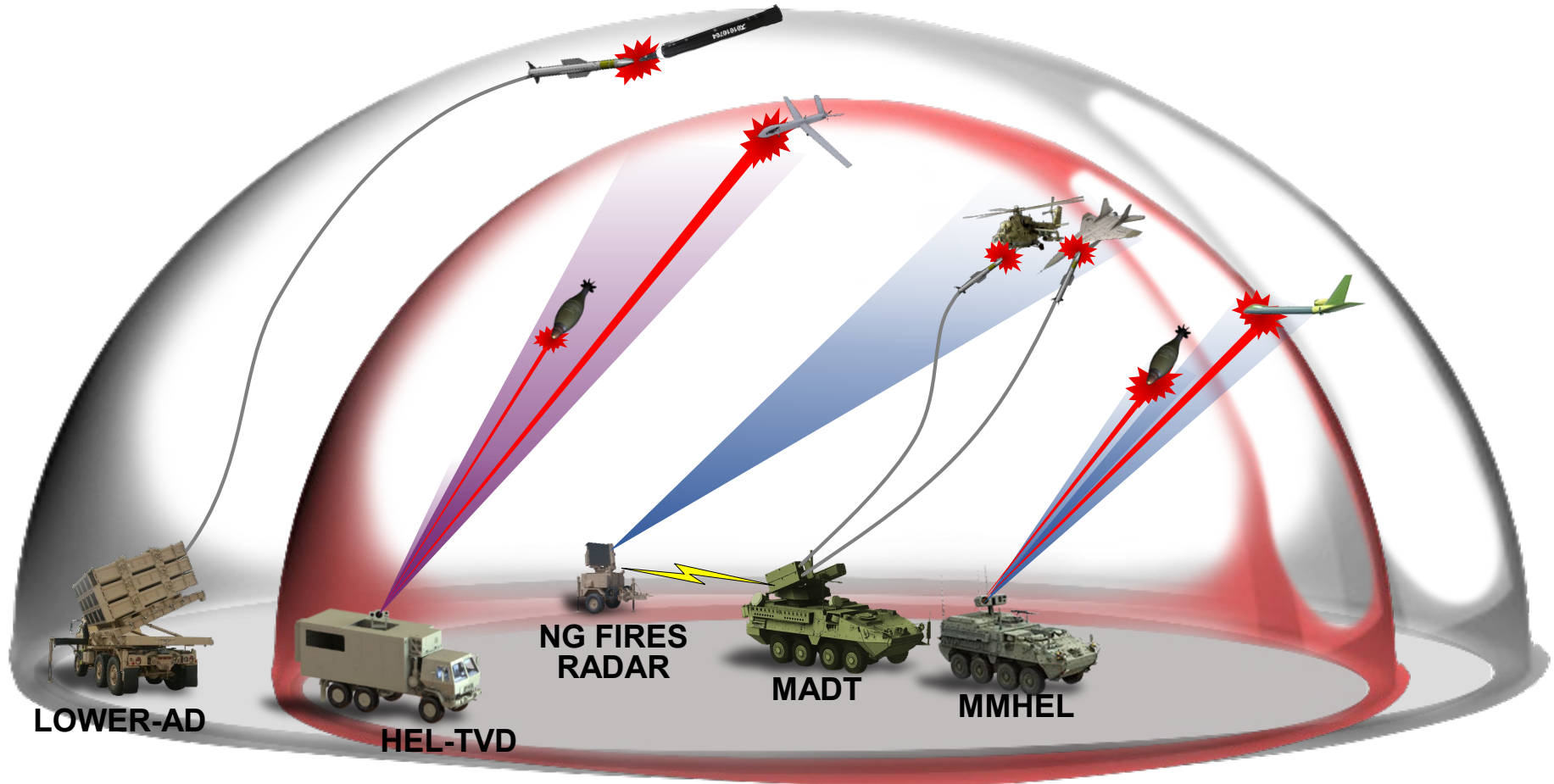


- 1) Protect maneuvering forces and their fixed and semi-fixed assets [M-SHORAD, IFPC, IBCS];
- 2) Defend critical assets in theater/operational support areas [IBCS, Patriot/LTAMDS, IFPC];
- 3) Help Joint/Area AD Cmdr create windows of air superiority [IBCS, joint mix of sensors/shooters]

* Army Air and Missile Defense (AMD) 2028 (March 2019)



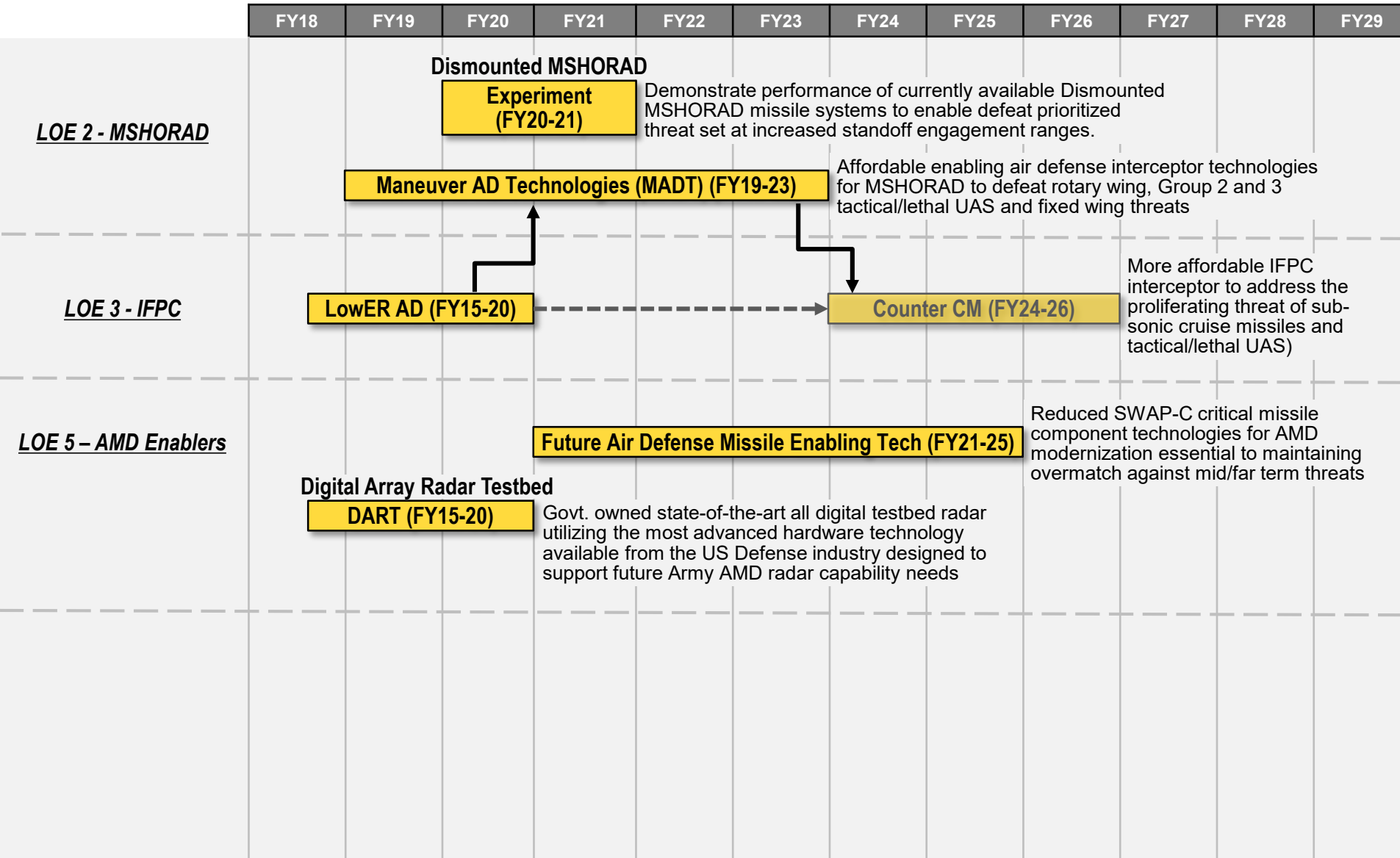
AMD CFT S&T PRIORITY PROJECTS (INCLUDES RCCTO DE EFFORTS)



Provide Capability to Engage Targets at Extended Range



CCDC AvMC AMD S&T ROADMAP



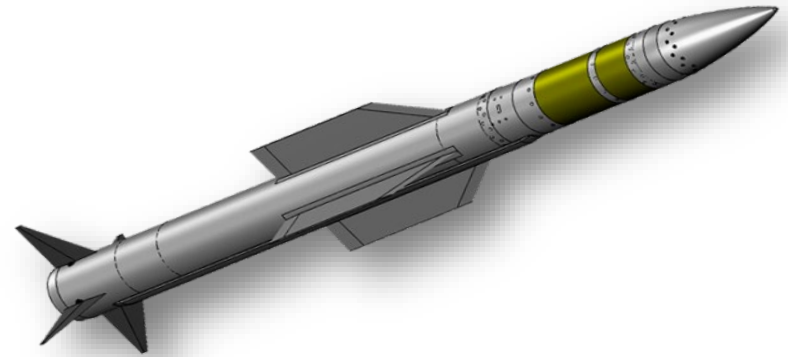


LOW-COST EXTENDED RANGE AIR DEFENSE (LOWER AD)



PURPOSE

- Develop and demonstrate a smaller and more affordable air defense interceptor to address the proliferating threat of sub-sonic cruise missiles and tactical/lethal unmanned aircraft systems (UAS).



IMPORTANCE TO THE ARMY

- Directly supports the AMD CFT Indirect Fire Protection Capability Priority (IFPC). Operationally, Lower AD is designed to provide an affordable interceptor to address the lower end of the Patriot threat set in an Army Integrated Air and Missile Defense construct.
- A focus of this S&T project is development of common guidance electronics unit that is sub caliber to the Lower AD missile body. This will allow the GEU to be utilized in smaller form factor missiles for different missions, providing the Army an opportunity for quantity purchases at a greatly reduced cost per unit.

OUTLOOK FOR THE FUTURE

- Demonstrate and transition an affordable interceptor enabling more effective and lower cost defense against saturating raids of cruise missiles and tactical/lethal UAS.
- At the completion of this project a Govt. owned Developmental Level Technical Data Package will provide a demonstrated reference design, allowing increased competition for engineering development and production.

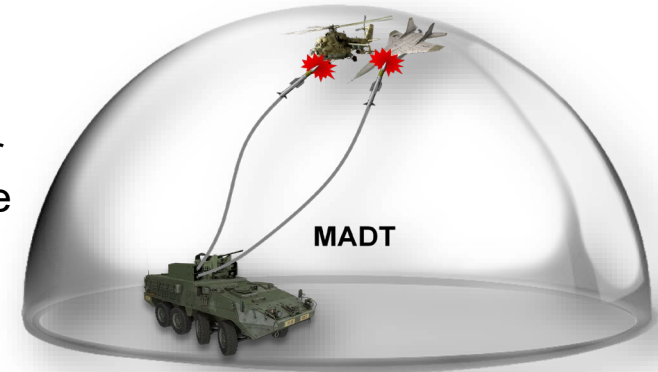


MANEUVER AIR DEFENSE TECHNOLOGIES (MADT)



PURPOSE

- Develop, integrate, and demonstrate affordable enabling air defense interceptor technologies for Maneuver Short Range Air Defense to defeat rotary wing, Group 2 and 3 tactical/lethal unmanned aircraft systems and fixed wing threats.



IMPORTANCE TO THE ARMY

- Directly supports the AMD CFT M-SHORAD Priority. Operationally, this S&T effort will enable maneuver forces freedom of movement with survivability by demonstrating an affordable interceptor capable of defeating stressing M-SHORAD threats.
- Will utilize a common guidance electronics unit developed in conjunction with the complementary LowER AD S&T Project, providing the opportunity for quantity purchases to greatly reduce unit production costs. The MADT interceptor is being designed to be compatible with current and future M-SHORAD platforms.

OUTLOOK FOR THE FUTURE

- Demonstrate and transition an enhanced M-SHORAD interceptor to enable maneuver forces to defeat rotary wing, UAS, and fixed wing threats. The development of an affordable interceptor compatible with current and future M-SHORAD platforms enables more effective and lower cost defense against these threats.
- At the completion of this project a Govt. owned Developmental Level Technical Data Package will provide a demonstrated reference design, allowing increased competition for engineering development and production

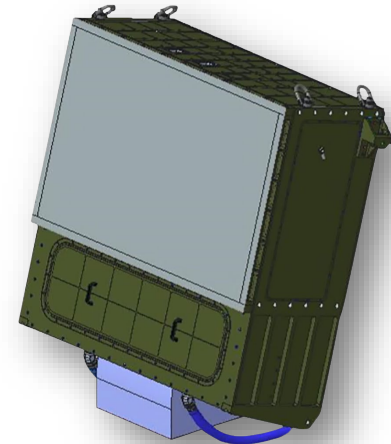


DIGITAL ARRAY RADAR TESTBED (DART)



PURPOSE

- Design and develop a Government owned state-of-the-art all digital Active Electronically Scanned Array (AESA) testbed radar utilizing the most advanced hardware technology available from the US Defense industry designed to support future Army AMD needs.



IMPORTANCE TO THE ARMY

- Operationally, DART provides the critical foundation to enable development of enhanced algorithms, waveforms, and other capabilities and facilitates the direct transition to current and emerging Army programs to meet objective requirements, while maintaining technology options that will continue to outpace the ever-evolving air and missile threats .

OUTLOOK FOR THE FUTURE

- FY20 demonstration of DART hardware functionality to support future S&T development of prioritized capability enhancements for current and emerging Army multi-mission radars.



FUTURE AIR DEFENSE MISSILE ENABLING TECHNOLOGY



PURPOSE

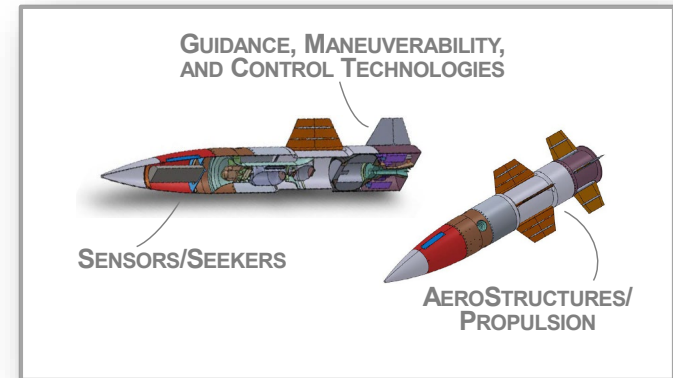
- Developing missile component technologies to provide reduced size, weight, power, and cost for Maneuver – Short Range Air Defense (M-SHORAD), SHORAD, and Lower Tier, essential to maintain overmatch against mid- and far-term stressing threats.

IMPORTANCE TO THE ARMY

- Applied research investment in Sensors/Seekers, Guidance/Maneuverability/Control, and Aerostructures/Propulsion technologies will enable defeat of advanced AMD threats at objective ranges by overcoming existing limitations in Air Defense interceptor velocity, maneuverability, and sensing.

OUTLOOK FOR THE FUTURE

- This is an FY21 new Start project.





AMD S&T ENABLING TECHNOLOGIES



MANEUVER AIR DEFENSE



Development of technologies that support low cost, small form factor air defense interceptors for the maneuver force.

SENSORS/SEEKERS

RF and IR Tech

Algorithms



Seeker technology and algorithms to support the broad air defense mission set.

ADVANCED PROPULSION

Advanced Divert and Attitude Control Systems

Air-breathing/High Speed Propulsion Tech

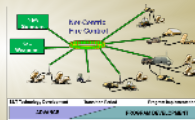


Propulsion technologies to increase interceptor range, velocity, and maneuverability.

FIRE CONTROL

Hardware

Techniques



Fire Control hardware and software to optimize the integration of current systems, enable "shoot on the move," and facilitate engagements of advanced threats.

RESILIENCY



Technologies to enable air defense performance in all environments.



CCDC AvMC MISSILE S&T ALIGNMENT TO ARMY MODERNIZATION PRIORITIES



Army Modernization Priorities

LONG RANGE PRECISION FIRES

Technologies for the development, integration and delivery of long range fires at the tactical, operational, and strategic echelons to restore overmatch, improve deterrence, and disrupt A2AD on a complex, contested and expanded battlefield.

AIR & MISSILE DEFENSE

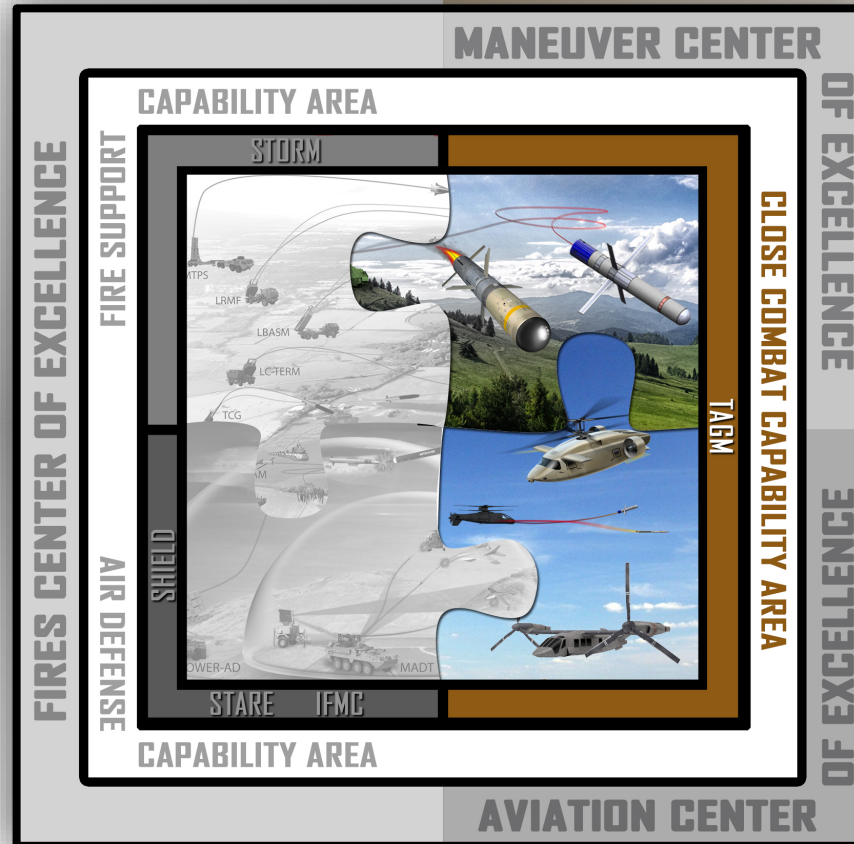
Technologies for the development of mobile air defense systems that reduce the cost curve of missile defense, restore overmatch, survive volley-fire attacks, and operate within sophisticated A2AD and contested domains.

NEXT GENERATION COMBAT VEHICLE

Technologies for active protection systems and enhanced lethal effects that will increase our ability to survive and win in the complex and densely urbanized terrain of an intensely lethal and distributed battlefield where all domains are continually contested.

FUTURE VERTICAL LIFT

Technologies for the development, integration, and delivery of aviation launched air-to-ground and air-to-air missile systems to restore overmatch within sophisticated A2AD and contested domains.



ENGAGE FIRST

EXPAND THE DOME

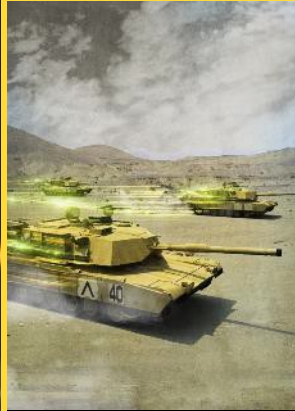
ON THE MOVE



CLOSE COMBAT MODERNIZATION PRIORITY



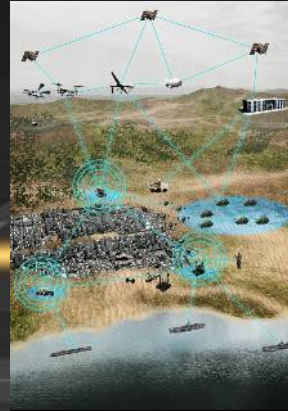
**LONG RANGE
PRECISION FIRES**



**NEXT GENERATION
COMBAT VEHICLE**



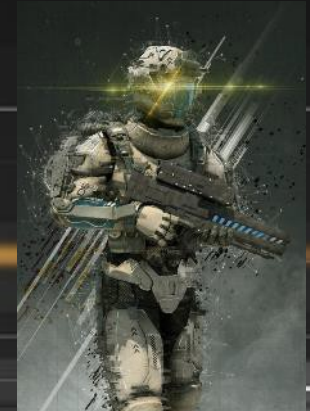
**FUTURE
VERTICAL LIFT**



**ARMY
NETWORK**



**AIR & MISSILE
DEFENSE**



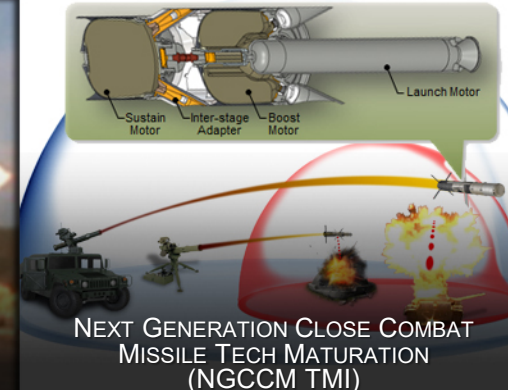
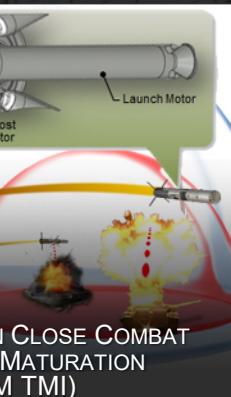
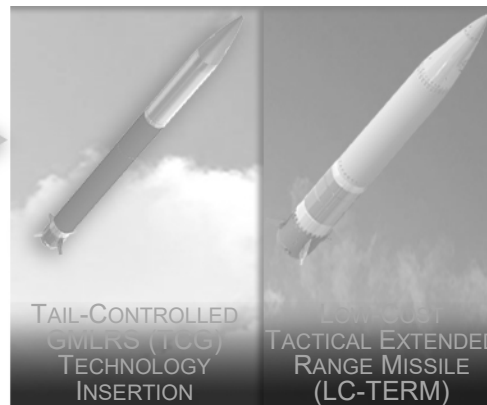
**SOLDIER
LETHALITY**

Supporting Army and Joint Readiness now and in the Future Multi-Domain Operation (MDO) Environment

Close Combat will provide Technologies for active protection systems and enhanced lethal effects that will increase our ability to survive and win in the complex and densely urbanized terrain of an intensely lethal and distributed battlefield where all domains are continually contested.



CLOSE COMBAT CAPABILITY AREA - MAJOR PROGRAMS ALIGNED TO ARMY PRIORITIES





FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29
NGCCM TMI											



NG CCM: EXPERIMENTAL PROTOTYPING DEMO (TMI)



PURPOSE

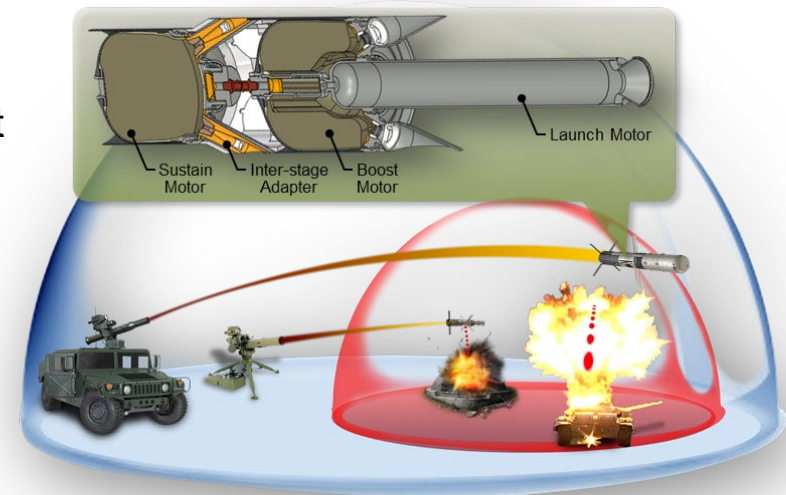
- Mature and flight demonstrate a Next Gen Close Combat Missile (NG CCM) with a multi-pulse, boost-sustain flight propulsion system providing extended range and decreased time of flight for enhanced soldier/platform survivability

IMPORTANCE TO THE ARMY

- Increased range of lethal effects over currently fielded TOW
- Increased Rate of Fire
- Increases Soldier Survivability by reducing gunner exposure time and integrated IM and ignition safety features

OUTLOOK FOR THE FUTURE

- Demonstration and transition of a tactical representative Missile Propulsion System
- Flight demonstration of a missile system with increased Range and decreased TOF
- Performance data/reports to inform requirements



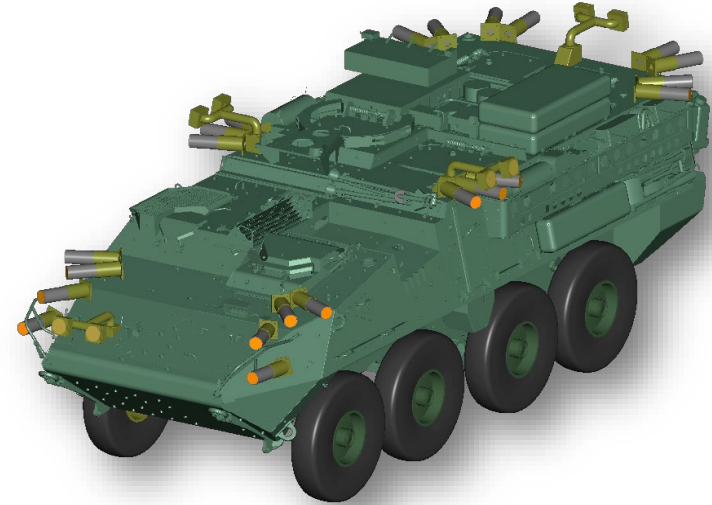


GROUND SYSTEM ACTIVE DEFENSE (GSAD) HARD-KILL ACTIVE PROTECTION PLATFORM INTEGRATION EXPERIMENT



PURPOSE

- Protect light armored combat vehicles from anti-armor threat weapons such as rocket-propelled grenades (RPG), anti-tank guided missiles (ATGM), and recoilless rifle projectiles (RR) that cannot be defeated by other means.
- Identify and resolve vehicle integration issues associated with fielding of effective hard-kill active protection systems (APS) on combat platforms.



IMPORTANCE TO THE ARMY

- Products enable earliest possible fielding of combat-effective Hard-Kill APS.
- Platform integration applicable to wide range of Hard-Kill APS technologies and combat platforms.
- Directly supports CSA priorities:
 - Enabler for “Next Gen Combat Vehicles”
 - Supports “Active Protection” initiative
- Risk reduction for “Expedited NDI APS evaluation.”
- Enable fielding of APS effective against RPG, ATGM, & Recoilless Rifle.

OUTLOOK FOR THE FUTURE

- MAPS compliant Production Ready APS integrated with combat platform demonstrated
- Government-owned Level 1 Technical Data Package (TDP)



CLOSE COMBAT : AVIATION / GROUND MISSILE SYNERGISTIC PORTFOLIO



- Close Combat Aviation and Ground requirements and constraints are trending toward convergence in many areas
 - Similarities: basic operational concept, threat sets, guidance schemes, physical boundaries, cost goals
 - Differences: maximum range, time-to-target, loiter time
- Close Combat Capability Area is forming a holistic and more efficient approach to developing the next generation close combat missile portfolio
 - Leverages common investment across all Close Combat component & system studies
 - Develops coherent and rapidly accessible database of Close Combat candidate technologies, concepts, and capabilities
- The resulting Close Combat Family of Missiles will be mindful to not leave legacy systems behind while leaning forward to satisfy the requirements of the future force

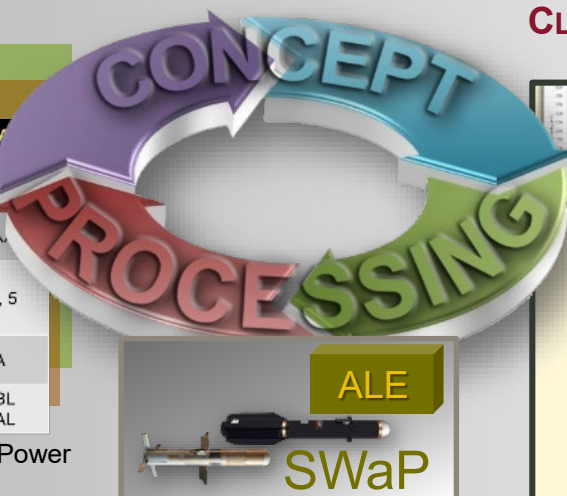
CLOSE COMBAT REQUIREMENTS

Aviation

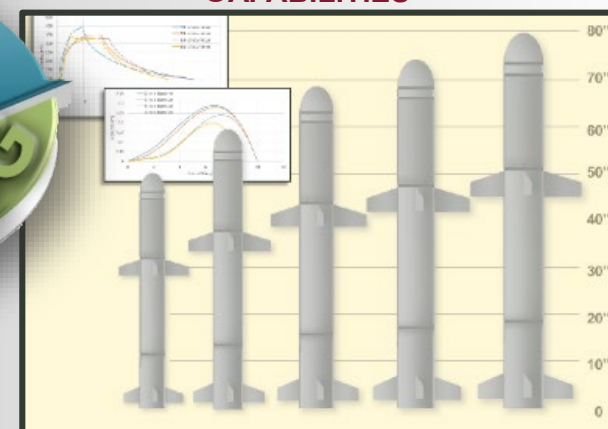
Ground

Capability	Anti-Armor	MRGM-ER	HSMM	LRPM	SPE
Range	10km	35km+	40km	40km+	16k
AUPC ≤	\$150k	\$150k	\$150k	\$150k	\$40
Platform	NGCV-OMFV FARA	NGCV-OMFV FARA	NGCV-OMFV FARA	FARA	FARA
Threats: (1) MBT, (2) ADS, (3) AFS, (4) Personnel, (5) APC, (6) Bunkers	1, 3, 4, 5, 6	1, 2, 3	1, 2, 3, 4, 5, 6	1, 2, 3	2, 4, 5
Direct Attack/ Loiter	DA	DA Loiter	DA Loiter	DA Loiter	DA
Beyond LOS (LOBL vs LOAL)	LOBL LOAL	LOBL LOAL	LOBL LOAL	LOBL LOAL	LOBL LOAL

ALE = Air Launched Effects SWaP = Size, Weight and Power



CLOSE COMBAT FAMILY OF MISSILES -CAPABILITIES-





CLOSE COMBAT MODERNIZATION PRIORITY



**LONG RANGE
PRECISION FIRES**



**NEXT GENERATION
COMBAT VEHICLE**



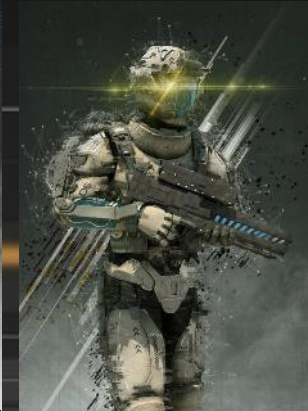
**FUTURE
VERTICAL LIFT**



**ARMY
NETWORK**



**AIR & MISSILE
DEFENSE**



**SOLDIER
LETHALITY**

Supporting Army and Joint Readiness now and in the Future Multi-Domain Operation (MDO) Environment

Future Vertical Lift will provide technologies for the development, integration, and delivery of aviation launched air-to-ground and air-to-air missile systems to restore overmatch within sophisticated A2AD and contested domains.



FUTURE VERTICAL LIFT LINES OF EFFORT



Army Aviation is committed to maintaining vertical lift dominance with the development of critical combat systems enabling the joint force to operate dispersed over wide areas with the ability to **rapidly converge** in order to **penetrate** the multiple layers of **stand-off** employed by the threat, **dis-integrate** A2/AD systems, and **exploit** this advantage with enhanced Attack/Reconnaissance, Air Assault and MEDEVAC capabilities.

FARA Capability Set 1 (LOE 1)



Future Attack Reconnaissance Aircraft: Critical combat system needed to prevail in future wars by enabling Army Aviation to achieve a “leap-ahead” in lethality, survivability, and reach to find, fix, and finish our pacing threats.

FUAS (LOE 2)



Future Unmanned Aircraft Systems: Advanced teaming FVL with next generation UAS delivering lethal and non-lethal air launched effects enables cross-domain fires to penetrate and dis-integrate enemy A2AD systems and exploit expanded maneuver to overmatch peer adversaries.

FLRAA Capability Set 3 (LOE 3)



Future Long Range Assault Aircraft: Essential to exploit the windows of opportunity created by FARA and advanced teaming with UAS/ALE with its increased speed and reach providing significantly more lethal and effective Air Assault and MEDEVAC capabilities on the future battlefield.

MOSA (LOE 4)



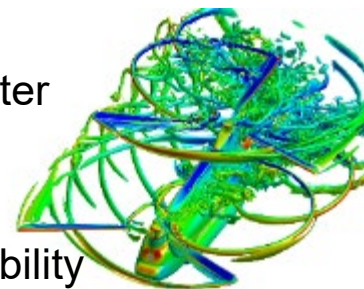
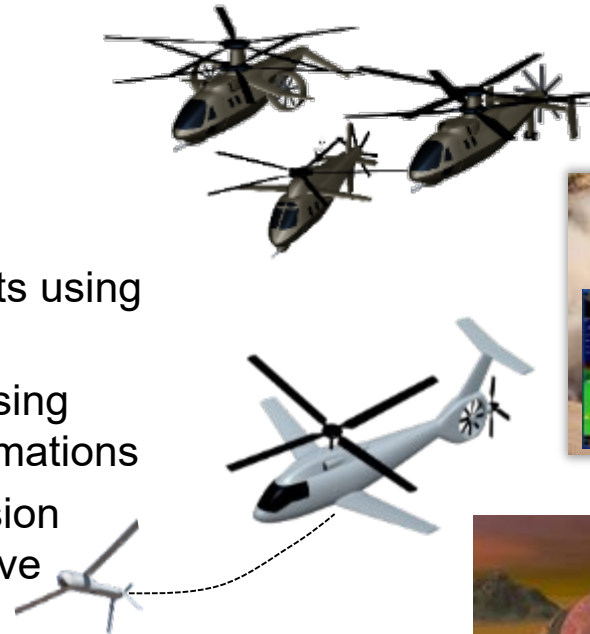
Modular Open Systems Approach: The government defined Modular Open System Approach will establish the digital backbone of FVL aircraft allowing for rapid and affordable integration of innovative avionics and mission equipment technologies into our platforms.



STRATEGIC GOALS



- Provide air vehicles and technologies for battlefield persistence and rapid response
- Implement open systems architectures
- Develop air-launched effects to conduct mission sets using modular payloads
- Demonstrate autonomy and cooperative teaming using autonomous decision-making in heterogeneous formations
- Shape the human-system interfaces to enable mission command from a battle station with reduced cognitive demands
- Explore novel power generation, storage, and distribution technologies
- Dominate complex environments through navigation and airspace management for teams operating in natural clutter and high-density airspace
- Reduce fielding timelines and lower technical risks
- Sculpt the government workforce to respond with adaptability and agility while retaining core competencies





AVIATION S&T- MAJOR PROGRAMS ALIGNED TO ARMY PRIORITIES



**FUTURE
VERTICAL LIFT**



FUTURE ATTACK RECONNAISSANCE AIRCRAFT
COMPETITIVE PROTOTYPE (FARA-CP)



JOINT MULTI-ROLE (JMR)



INTEGRATED MISSION
EQUIPMENT (IME) FOR
VERTICAL LIFT SYSTEMS



ADVANCED TEAMING DEMONSTRATION



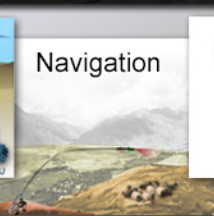
AIR LAUNCHED EFFECTS



MODULAR
MISSILE TECHNOLOGIES (MMT)
MODULAR OPEN SYSTEM ARCHITECTURE FOR
MISSILES



Datalink



Navigation



Lethality



Fire Control

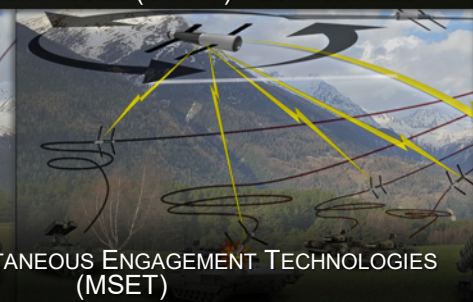
SINGLE MULTI-MISSION ATTACK MISSILE (SMAM) TECHNOLOGIES



MULTI-ROLE GUIDED MISSILE - EXTENDED RANGE
(MRGM-ER)

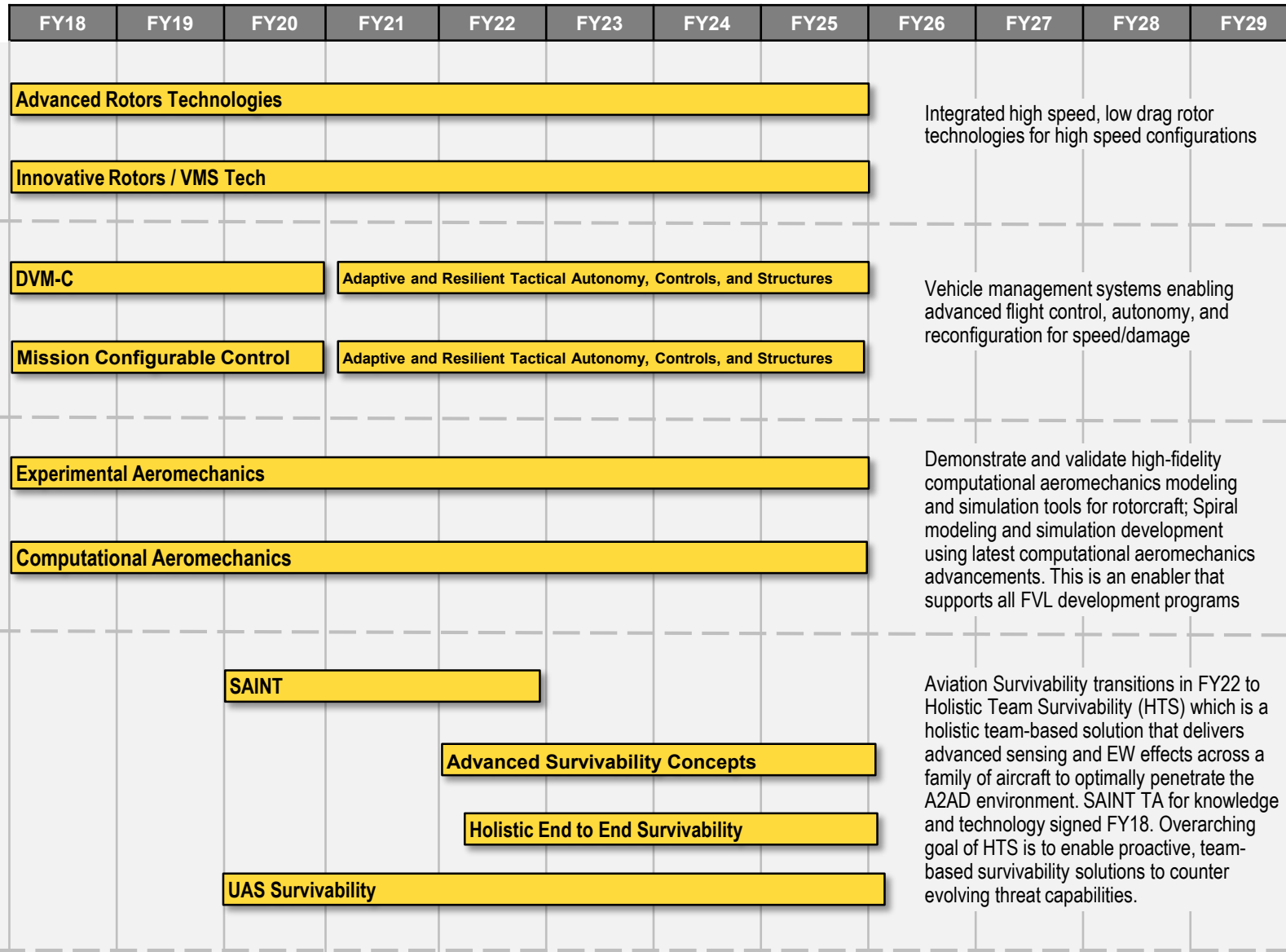


MULTIPLE SIMULTANEOUS ENGAGEMENT TECHNOLOGIES
(MSET)



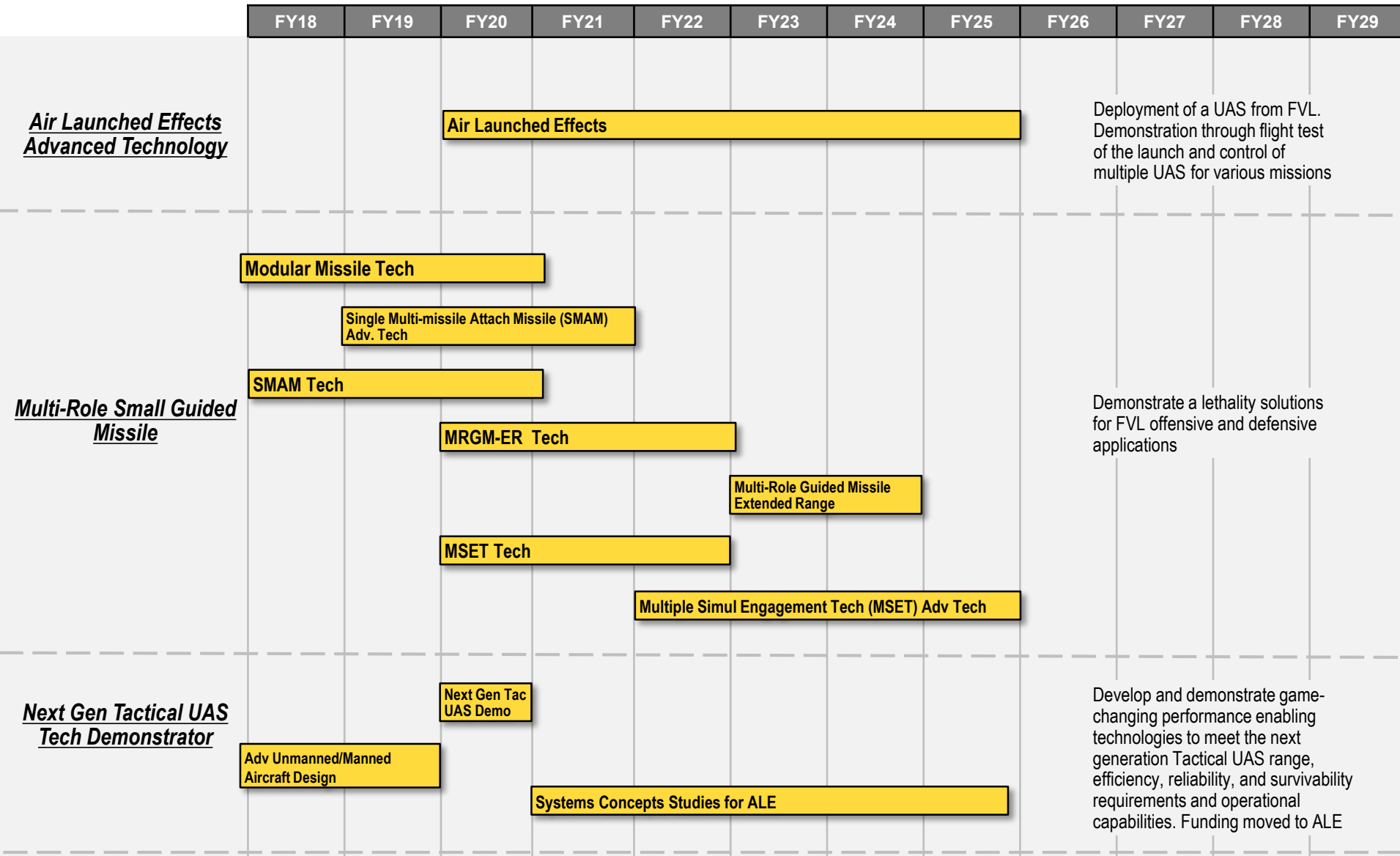


FUTURE VERTICAL LIFT LOE 1: CS1 FARA- ROADMAP



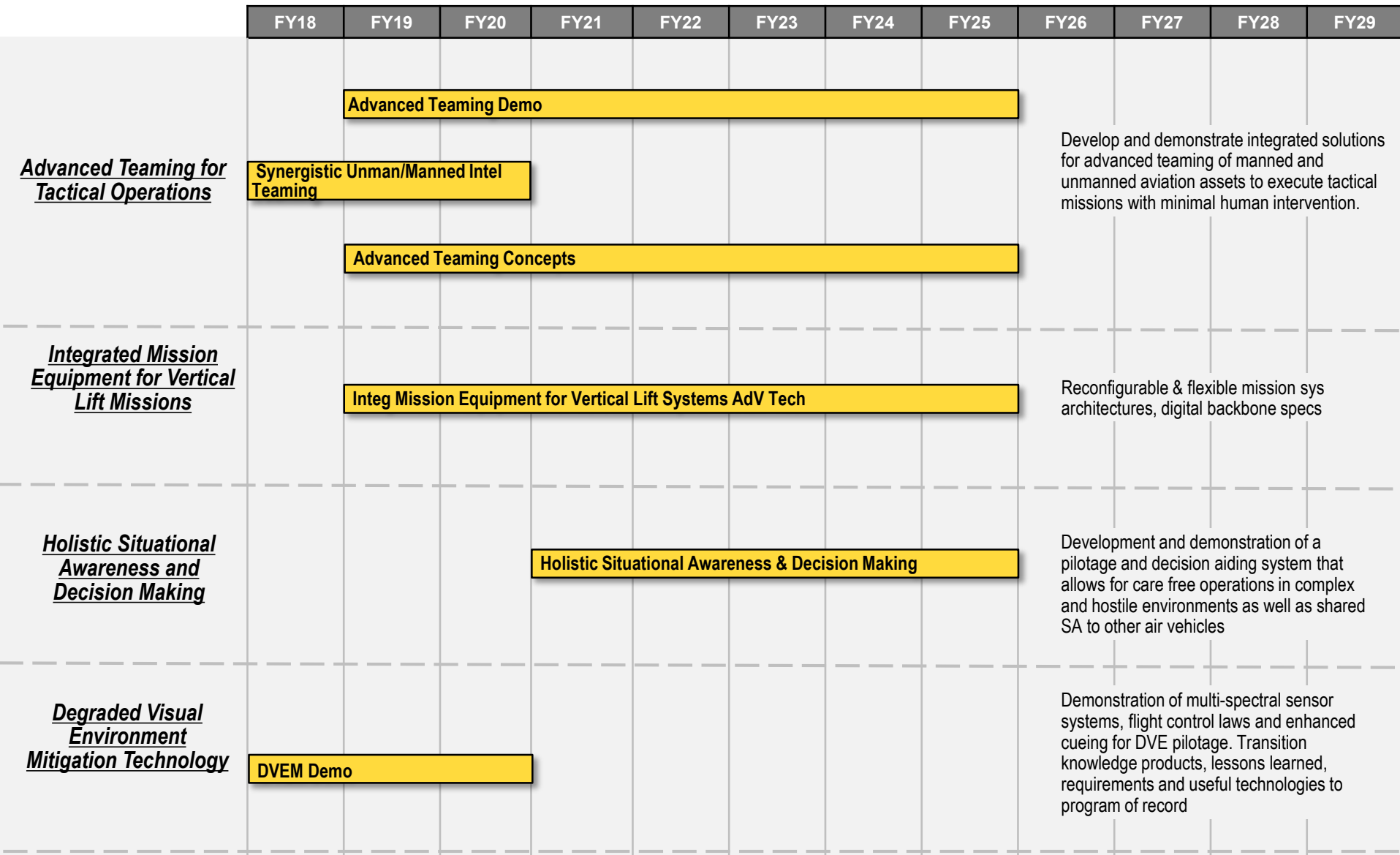


FUTURE VERTICAL LIFT LOE 2: FUAS- ROADMAP





FUTURE VERTICAL LIFT LOE 3: MOSA- ROADMAP

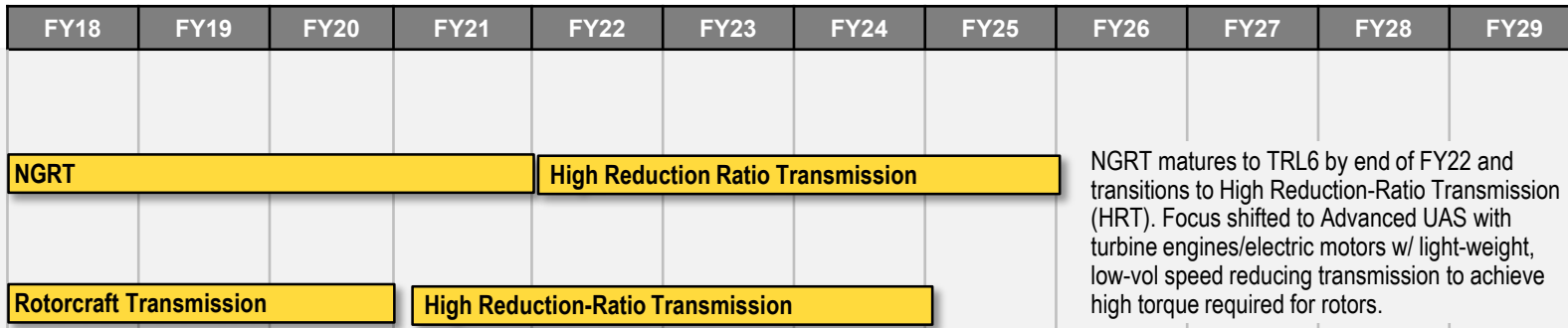




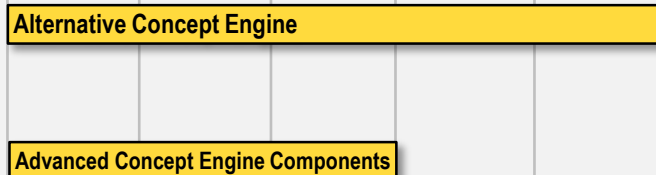
FUTURE VERTICAL LIFT LOE 4: CS3 FLRAA– ROADMAP



Next Generation Rotorcraft Transmission

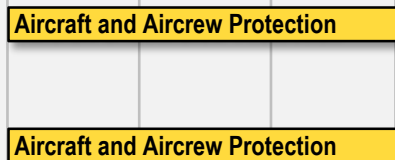


Alternative Concept Engine



Power and thermal management of the engine, Advanced Energy Storage and Power and Thermal Management Technologies to provide sufficient electrical power and thermal load capability for FVL aircraft.

Aircrew and Aircraft Protection



Environmental & hostile threat vulnerability reduction, susceptibility reduction and crashworthiness improvement for total survivability

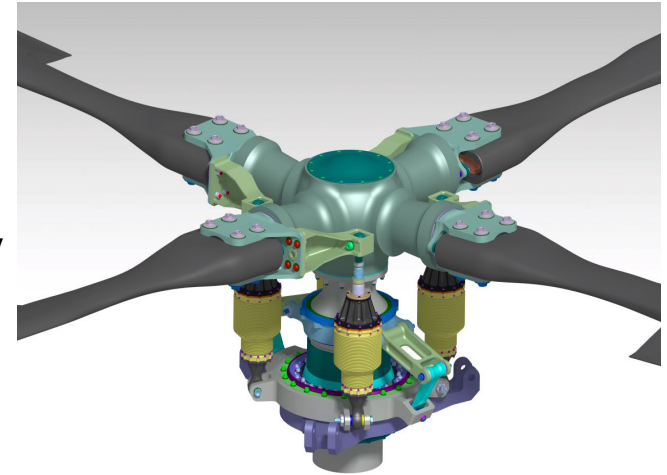


ADVANCED ROTORS



PURPOSE

- FVL requires revolutionary advances in rotor design to increase manned and unmanned aircraft system performance (e.g. range, speed, and payload) and reliability to achieve overmatch in the peer/near peer battlespace.



IMPORTANCE TO THE ARMY

- Directly supports the FVL CFT FARA Priority. Operationally, this S&T effort will enable maneuver forces greater performance by demonstrating high speed, low drag rotors.
- Will develop and demonstrate individual blade control electromechanical and other novel actuator designs tailored for FVL rotor system characteristics with associated size, weight, and power constraints.

OUTLOOK FOR THE FUTURE

- Conduct detailed design and testing of high speed, highly efficient FVL rotor systems
- Conduct individual blade control actuator performance testing
- Investigate durability performance to determine robustness of rotor blade advanced erosion protection technologies



DIGITAL VEHICLE MANAGEMENT & CONTROL



PURPOSE

- Project ensures Future Vertical Lift (FVL) program success through accurate flight dynamics models, advanced flight controls, state of the art own-ship autonomy, and evolving handling qualities specifications for modern manned and unmanned platforms.

IMPORTANCE TO THE ARMY

- Significantly reduced time/cost/risk by eliminating iterations and redesigns late in program.
- Ability to exploit extreme/degraded environmental conditions as force multiplier.
- Ability to fight and win in presence of hardware failure or battle damage.
- Superior high-speed agility and maneuverability.
- Autonomous and optionally piloted flight.

OUTLOOK FOR THE FUTURE

- Complete Mission Management Computer (MMC) upgrade and transition of Rotorcraft Aircrew Systems Concepts Airborne Laboratory (RASCAL) capabilities to UH-60M platform
- Complete development of high-speed Handling Qualities criteria, response types, and Mission Task Elements (MTE) to exploit high speed capabilities of FVL configurations



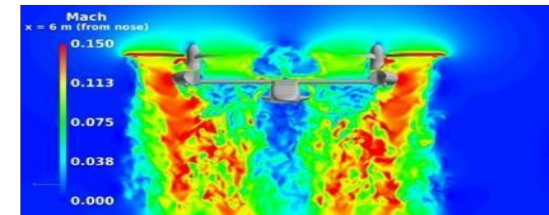
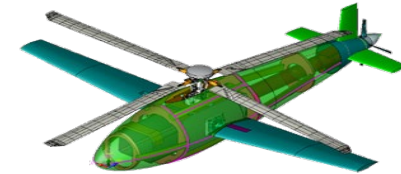
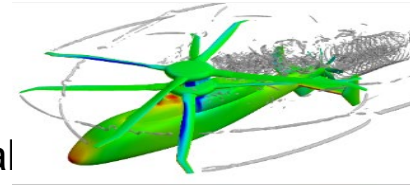


EXPERIMENTAL AND COMPUTATIONAL AEROMECHANICS



PURPOSE

- Project investigates new high fidelity computational methods to simulate aerodynamic effects & test methods of emerging rotorcraft lift technologies that could be incorporated into FVL designs.



IMPORTANCE TO THE ARMY

- Directly supports the FVL CFT FARA Priority. Operationally, this S&T effort will enable superior modeling, simulation, and experimental capabilities to verify and validate advanced designs.
- Will develop, verify, validate, and apply high-fidelity modeling and simulation software tools for rotorcraft aeromechanics (i.e. aerodynamics, structures) that reduce risk in the development and acquisition process.

OUTLOOK FOR THE FUTURE

- Investigate interactional aerodynamic effects of multi-rotor configurations
- Extend the state of the art for measurement & diagnostics techniques for rotor blade structural deformation
- Verify and validate high-fidelity computational tools for full-vehicle aeromechanics analysis of FVL rotorcraft engineering problems
- Reduce expensive & time-consuming flight testing to rectify unforeseen deficiencies in FVL platforms



AVIATION SURVIVABILITY



PURPOSE

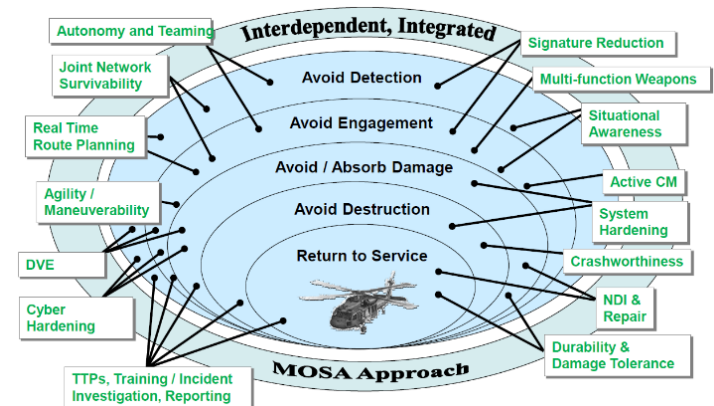
- Apply knowledge of the current and future threat environments to develop and demonstrate integrated capabilities to reduce FVL & FUAS platform susceptibility and vulnerability against peer/near peer Integrated Air Defense Systems.

IMPORTANCE TO THE ARMY

- Directly supports the FVL CFT FARA Priority. Operationally, this S&T effort will enable team-based aviation survivability in an advanced IADS environment through a multi-layered approach.
- Will develop a modular, open, and integrated approach for aircraft survivability technologies to avoid, deceive, or defeat adversarial integrated and networked threat systems: RF countermeasures, advanced sensors, and algorithms for threat detection/routing for threat avoidance.

OUTLOOK FOR THE FUTURE

- Mature and demonstrate route and maneuver planners for improved aircraft survivability
- Develop human machine interface and automation for reduced crew workloads during threat engagements, and improved survivability
- Develop and demonstrate UAS susceptibility & electromagnetic vulnerability reduction technologies with minimal impacts to system performance and cost
- Develop and explore new team based survivability concepts to increase aircraft survivability in rapidly and constantly evolving threat environments





AIR LAUNCHED EFFECTS



PURPOSE

- Provide expendable, flexible payload, unmanned aerial systems (UAS) that are organically carried and launched on demand from rotorcraft and large UAS to Find, Fix, Target, Track, Engage, and Assess threats.



IMPORTANCE TO THE ARMY

- Directly supports the FVL CFT FUAS priority. Operationally, this S&T effort will enable delivery of lethal and non-lethal effects deep into enemy territory, which increases battlefield situational awareness, accelerates the kill-chain, and improves survivability through increased stand-off range. True force multiplier especially when implemented as a collaborative Advanced Team.

OUTLOOK FOR THE FUTURE

- Integrate purpose-built air vehicles, common and open mission systems, advanced autonomy behaviors, and numerous effector payloads into an unmanned aviation system
- Demonstrate Detect, Identify, Locate, Report (DILR); Communications Relay; Decoy; Disrupt; and Lethal capabilities individually and as part of and collaborative UAS advanced team
- Demonstrate an Air Launched Effects UAS recovery system
- Deliver mature component technologies, system solutions, and knowledge incrementally to the ALE Program of Record for implementation within the Future Vertical Lift Ecosystem

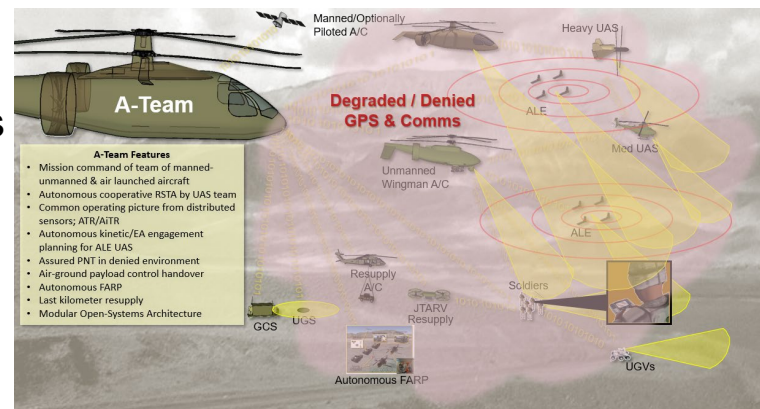


ADVANCED TEAMING



PURPOSE

- Develop and demonstrate advanced teaming capabilities for manned and unmanned aviation assets to execute tactical missions with minimal human intervention, while operating as part of a combined arms team in a contested multi-domain battle space.



IMPORTANCE TO THE ARMY

- Directly supports the FVL CFT MOSA priority. Operationally, this S&T effort will enable robust multi-UAS teamed operations in contested environments with degraded GPS/comms, survivability through shared situational awareness, and increased aviation team lethality and reach. True force multiplier especially through teams of Air Launched Effects and other FUAS.

OUTLOOK FOR THE FUTURE

- Demonstrate heterogeneous teams of unmanned aircraft autonomously executing coordinated Reconnaissance, Surveillance, Target Acquisition, Attack, Decoy, and Electronic Warfare missions capable of breaching a sophisticated Integrated Air Defense System
- Develop teaming mission systems architecture and demonstrate rapid integration of advanced autonomy and teaming technologies using a Modular Open Systems Approach (MOSA)
- Deliver technology products to PEO-Aviation early and often, showing increasing capability in successive increments by using agile development approaches



INTEGRATED MISSION EQUIPMENT FOR VERTICAL LIFT SYSTEMS



PURPOSE

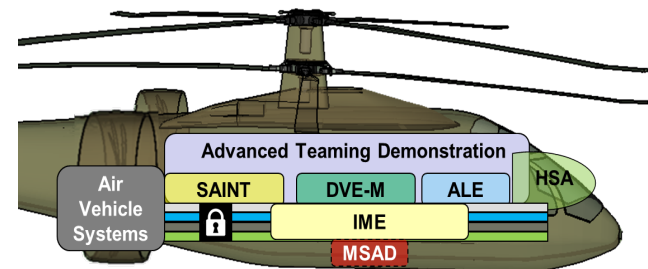
- Develop and demonstrate a mature integration approach enabling innovation and continuous improvement of mission systems independent of the air platform.

IMPORTANCE TO THE ARMY

- Directly supports the FVL CFT MOSA Priority and Army MOSA ICRD as an enabler for modernization to quickly counter emerging threats and manage obsolescence.
- Transitions foundational content to the FVL Architecture Collaboration Working Group.
- Delivers architecture and digital backbone requirements to FARA and FLRAA.
- Directly supports PEO-Aviation's strategic plan to rapidly acquire, deploy, upgrade and sustain portable capabilities without vendor lock.
- Establishes a method and environment to independently validate and verify products for MOSA.
- Develops a flying testbed to assess vendor products for MOSA in an operational environment.

OUTLOOK FOR THE FUTURE

- Perform Innovative Integration trade studies, begin laboratory testing of digital backbone candidate technologies, and perform proof of concept demos on core software infrastructure.
- Specify infrastructure software product line core assets and acquire initial capabilities.
- Expand Architecture Verification Environment capabilities, conduct experiments, and validate FVL architecture requirements.
- Specify the flying testbed's digital backbone, begin aircraft modifications, and solicit industry feedback for the Mission Systems Integration role.





HOLISTIC SITUATIONAL AWARENESS & DECISION MAKING

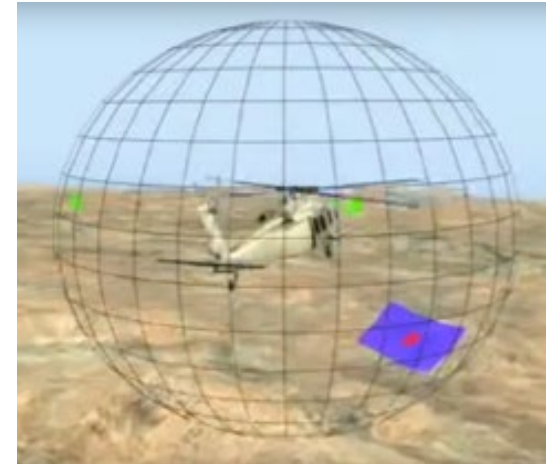


PURPOSE

- Project will develop and demonstrate pilotage and decision aiding system that allows for care free operations in complex and hostile environments.

IMPORTANCE TO THE ARMY

- Directly supports the FVL CFT MOSA Priority. Operationally, this S&T effort will enable future decision making with speed and accuracy required to achieve overmatch.
- Will define, develop, and demonstrate a FVL crew station with next generation human machine interface that improves and automates decision-making to enable FVL aircrew to tactically dominate a near peer/peer battlespace.



OUTLOOK FOR THE FUTURE

- Demonstrate decision-aiding algorithms, next-generation crew station technologies, and architectures needed to operate in complex and high-threat environments
- Develop multi-mode radar architecture for collision avoidance

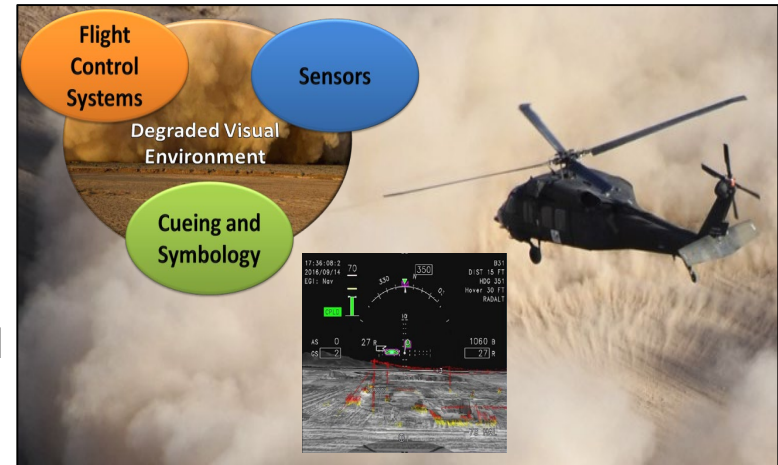


DEGRADED VISUAL ENVIRONMENT - MITIGATION



PURPOSE

- Project develops, matures, and demonstrates advanced sensors, cueing, and flight controls to provide the ability to maintain terrain and obstacle situational awareness in all Degraded Visual Environments (DVE) environments. Utilizes multi-modal, fused, sensor-driven guidance and obstacle avoidance in all phases of flight along with advanced cueing technologies.



IMPORTANCE TO THE ARMY

- Directly supports the FVL CFT MOSA Priority. Operationally, this S&T effort will enable aviation platforms to operate in complex terrain while encountering degraded natural or aircraft-induced environments.
- Provide a disruptive capability improvement that will allow crews to maintain a tactical advantage and convert DVE into a combat multiplier, deliberate and safe operations in all DVEs.

OUTLOOK FOR THE FUTURE

- Project completes and transitions this FY

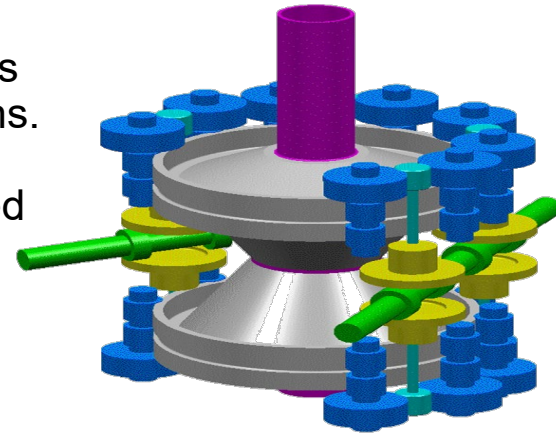


NEXT GENERATION ROTORCRAFT TRANSMISSION



PURPOSE

- Develop/demonstrate advanced rotorcraft drive system technologies that enhance current aircraft and enable future aircraft configurations. By the end of FY21, demonstrate to TRL 6 advanced technologies that enable variable-speed drive system designs (50-100% N_r speed range). By the end of FY25, demonstrate a 60:1 reduction ratio gearbox in two stages with 97% efficiency and made with corrosion resistant materials and advanced seals for improved reliability.



IMPORTANCE TO THE ARMY

- Directly supports the FVL CFT FLRAA Priority. Operationally, this S&T effort will enable FVL platforms to fly faster and farther.
- Lighter weight designs for better payload
- Higher reliability for improved readiness and sustainment
- Improved affordability through new materials and processes

OUTLOOK FOR THE FUTURE

- Variable speed transmission and controls will be integrated into a test facility. The integrated system will go through endurance testing to demonstrate functionality and reliability consistent with project goals.
- Investigate new corrosion resistant materials that allow higher contact stresses to enable high-reduction ratio gears that operate at high speeds

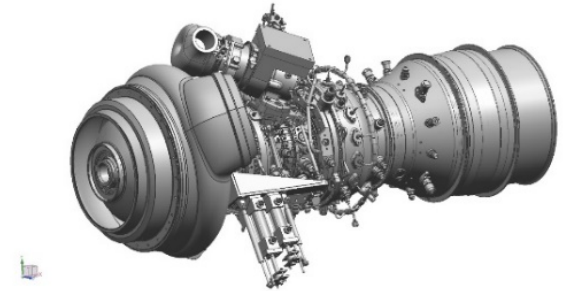


ALTERNATIVE CONCEPT ENGINE



PURPOSE

- Project develops and demonstrates advanced engine technologies at a system level to provide improved / mission-optimized performance, readiness, and durability across an expanding engine envelope for increased operational capability for Future Vertical Lift (FVL) platforms.



IMPORTANCE TO THE ARMY

- Directly supports the FVL CFT FLRAA Priority. Operationally, this S&T effort will enable aviation platform configurations that will fly faster and farther.
- Will develop and demonstrate variable speed power turbine technologies that will enable slowed rotor capability, which allows for significant improvements in speed and range for future vertical lift platforms. In addition, technologies that increase the fine sand separation efficiency and increase the durability of the engine will be demonstrated.

OUTLOOK FOR THE FUTURE

- Conduct engine performance demonstration and testing. Engine test metrics will include variable output speed, increased power turbine efficiency, high power to weight ratio, and increased durability.



AIRCREW & AIRCRAFT PROTECTION



PURPOSE

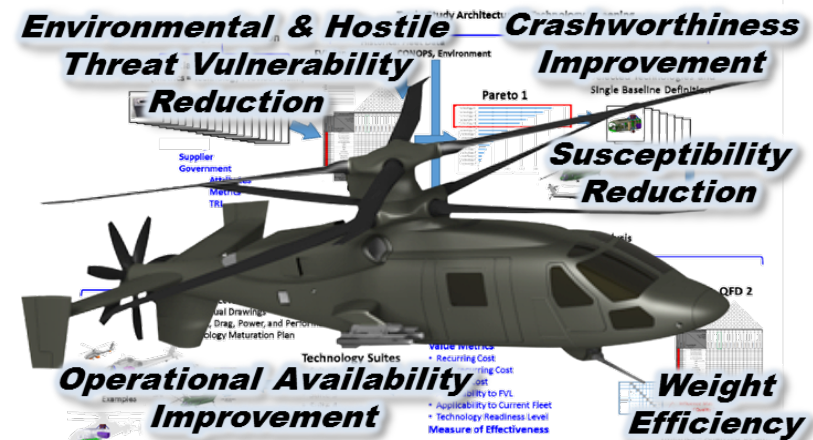
- Demonstrate an integrated, scalable platform solution for Future Vertical Lift (FVL) that increases operational availability and survivability, while improving weight efficiency and maintaining mission performance.

IMPORTANCE TO THE ARMY

- Directly supports the FVL CFT FARA and FLRAA priorities. Operationally, this S&T effort will enable improved aircraft performance, aircraft & occupant survivability, operational availability, and affordability.
- Will develop and demonstrate critical technologies for advanced structures, vulnerability reduction, and susceptibility reduction that consider the integration of the entire air vehicle design, rather than individual platform parts or individual technologies.

OUTLOOK FOR THE FUTURE

- Complete building and testing of most remaining demonstration articles
- Develop final reports and transition plans for FVL-targeted total survivability technologies





MODULAR MISSILE TECHNOLOGIES



PURPOSE

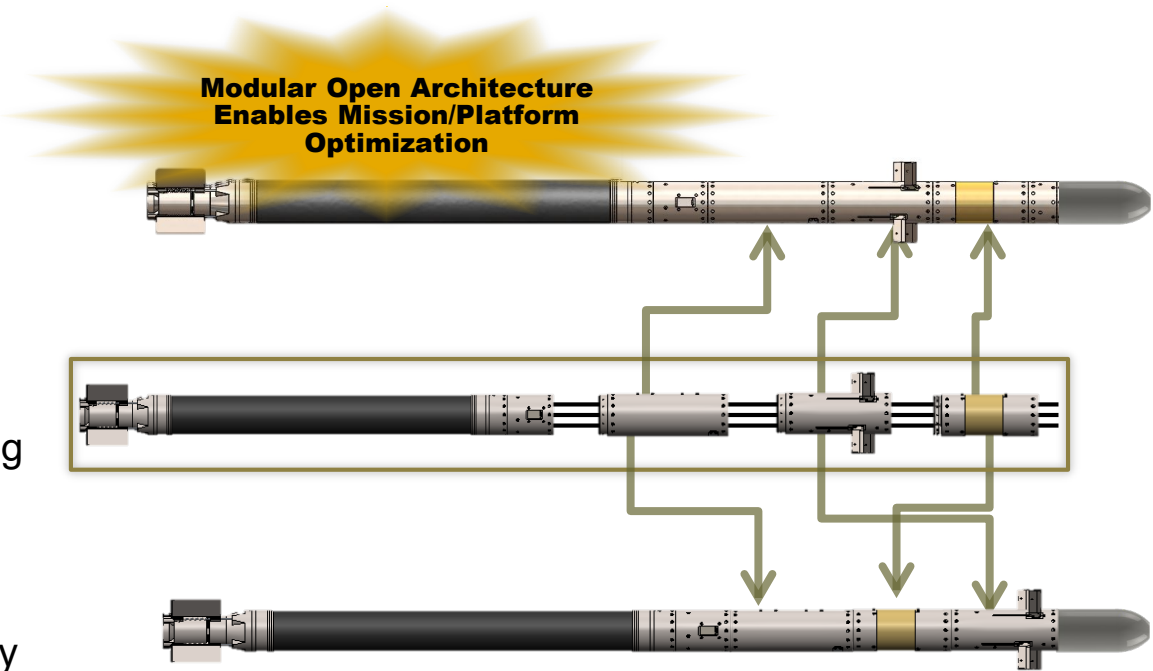
- Develop and demonstrate modular Small Guided Missile (SGM) technology providing increased lethality and tailorability for manned and unmanned Aviation platforms

IMPORTANCE TO THE ARMY

- Proven Modular Architecture resulting in Life Cycle Cost savings and rapid evolutionary upgrades
- Increased stand-off range
- Trajectory shaping to more effectively engage fleeting targets and reduce collateral damage
- Reduced missile weight enabling increased stowed kills

OUTLOOK FOR THE FUTURE

- Inertial Guided flight test of form-factored 2.75 modular forward firing SGM prototype, exercising propulsion and GNC
- Open architecture and standard interfaces supported by change-tolerant algorithms
- Level 1 TDP for components, architecture





SINGLE MULTI-MISSION ATTACK MISSILE TECHNOLOGIES (SMAM)

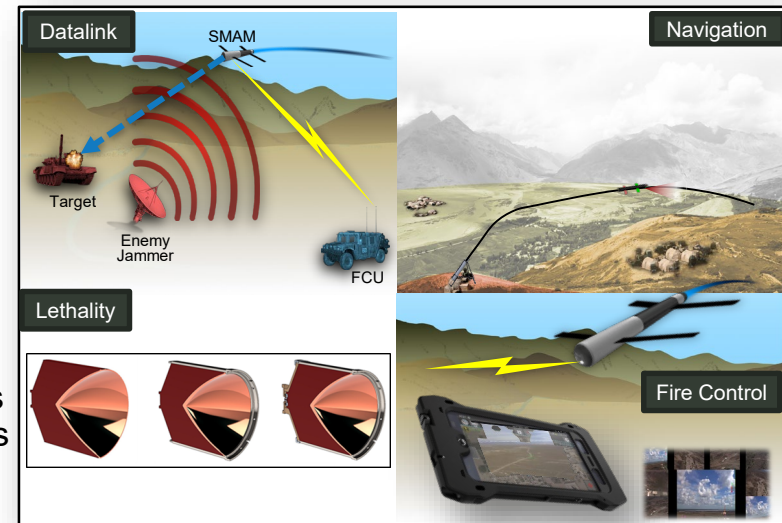


PURPOSE

- Demonstrate enabling technologies for a prototype NLOS precision strike missile with man-in-the-loop (regret avoidance) and loiter for situational awareness, targeting, and lethal effects against high-value targets to support Multi-Domain /expeditionary on-the-move capability in contested environments

IMPORTANCE TO THE ARMY

- Extended range situational awareness, targeting, and lethal effects against targets for Ground Combat vehicles, and Aviation platforms
- Operate in contested RF (GPS, Comms) environments
- Flight path maneuverability for increased effectiveness
- Enable future cross domain applications to include ground vehicle and maritime platform launched
- Provide Army User-desired SMAM capabilities, leveraging ongoing SOF prototyping efforts
- Expeditionary capability or reach-back from fixed site
- Inform Aviation and Maneuver concepts of employment
- Component technologies will transition to MRGM-ER for further development, platform integration and missile flight demonstration



OUTLOOK FOR THE FUTURE

Technology Demonstrations of the following:

- Precision Nav/targeting in contested environments
- Secure datalink for contested environments providing imagery/C2 for Man-in-the-loop positive ID and/or Wave-off (regret avoidance)
- Multi-effects warhead
- Optimized hardware agnostic single operator Fire Control, hosted on COTS hardware with Govt. common HMI to support SMAM and future multi-missile control



MULTI-ROLE GUIDED MISSILE – EXTENDED RANGE (MRGM-ER)



PURPOSE

- Identify, Demonstrate, Analyze, and Assess key component technologies to support non-line-of-sight missile development providing man-in-the-loop situational awareness, targeting, and high value target defeat for Aviation platforms that can successfully operate in A2AD/IADS environments.

IMPORTANCE TO THE ARMY

- Increases lethality and platform survivability by increasing standoff and lethal effects compared to current expeditionary weapons.
- Provides the ability to operate in contested environments and provides lethality against future high value targets.
- Enables cross domain applications for aviation and ground vehicle platforms.

OUTLOOK FOR THE FUTURE

- Laboratory demonstration of key component technologies
- Technical Data Package including designs, drawings, models, simulation, interface control documentation, software and hardware test data and analysis reports





MISSILE MULTIPLE SIMULTANEOUS ENGAGEMENT TECHNOLOGIES (MSET)



PURPOSE

- Platform integration and demonstration of a scalable, organic NLOS precision strike missile capability to rapidly defeat swarming and/or disbursed hard armor and other high-value targets to support Multi-Domain Operations / expeditionary on-the-move capability

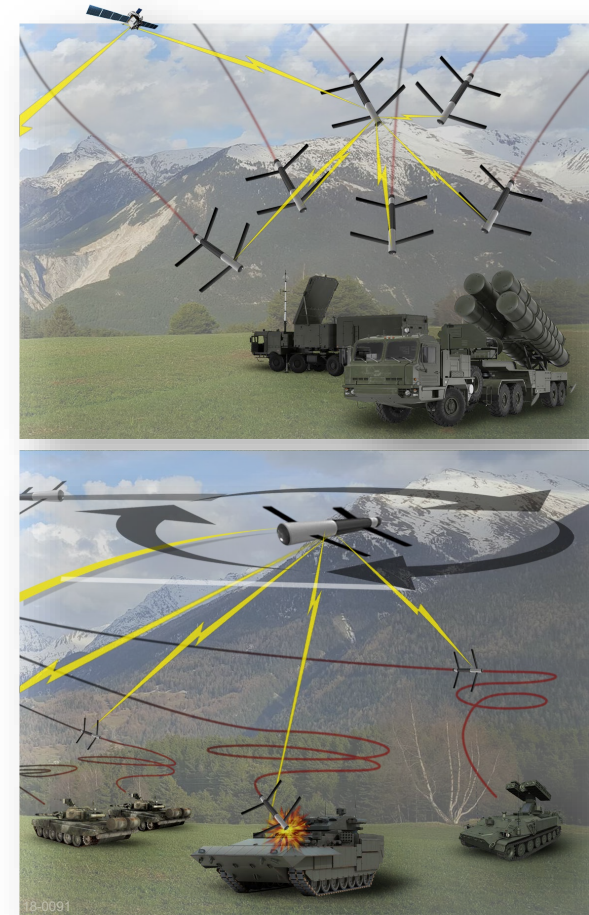
IMPORTANCE TO THE ARMY

- Provides NLOS precision engagement capability against multiple simultaneous threats at extended ranges with reduced operator workload
- Extended range situational awareness, targeting, and lethality for ground combat vehicles and aviation platforms.
- Enable future cross domain applications: ground and maritime platform launched
- Enables Faster than Human Reaction Time
- Provides area suppression or precision effects
- Enable emerging MUM-T & RAS Maneuver concepts
- Leverage interceptor utilizing MRGM-ER S&T component technologies

OUTLOOK FOR THE FUTURE

Flight Demonstration of:

- Simultaneous multiple launch, control, and supervised autonomous terminal engagement of multiple missiles against stationary and moving hard/soft targets
- Image-based target discrimination/shared SA/lock-on
- Multi-missile control Digital Datalink with inter-missile cooperative networked Comms
- Multi-missile Organic C2 solution that handles all aspects of sensor integration, fire control, and airspace management
- Form-factored Multi-pack Launcher





FUTURE TECHNOLOGY PROGRAMS



PURPOSE

- Provide technology to support a smaller, fast, maneuverable missile.
- Scalable lethality to deliver defeat of future Integrated Air Defense Systems (IADS) and other threats when engaged in Multi-Domain Operations Anti-Access / Area-Denied (A2/AD) and urban warfare.

IMPORTANCE TO THE ARMY

- Increases aviation lethality and platform survivability by increasing missile standoff range, speed, and maneuverability; multi-threat lethal effects.
- Enables cross domain applications for aviation and ground vehicle platforms, including handoff capability.



OUTLOOK FOR THE FUTURE

- Missile Modular Open System Approach
- Tailorable missile propulsion for increased speed and trajectory optimization
- Multi-effects warhead for MDO threat overmatch
- Robust two-way comms/datalink to enable wave off, target reassignment, and regret avoidance
- GPS denied navigation sensors and algorithms
- Seekers to enable degraded visual environment engagement



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