Force Projection/Dominant Maneuver

G.01 Mine Hunter/Killer ATD

Objectives. Develop and demonstrate a precision neutralizer, enhanced detection performance, and command and control interaction for an integrated mine detector/neutralizer system. This integrated detector/neutralizer system will be installed onto a vehicle and controlled through tele-operation from a standard military tactical vehicle. The combined system will demonstrate a capability to precisely locate and neutralize individual surface-laid and buried antitank mines. This capability increases the operational tempo by avoiding time delays due to mines encountered during route clearance missions. The Mine Hunter/Killer (MH/K) ATD will demonstrate a capability of 2% or greater probability of detection over the Vehicle-Mounted Mine Detector (VMMD) ATD results, a 33% reduction in false alarms demonstrated at VMMD ATD, and neutralization performance of greater than a 90% probability of kill.

Payoffs. The MH/K ATD will demonstrate a reduced risk to soldiers, improved operational speeds, improved detection capabilities, a reduced mine neutralization logistical burden, and electronic mine marking. The MH/K ATD, started in FY97, incorporates a close-in-detection sensor suite with standoff mine neutralization systems. Soldier risk is reduced by removing soldiers from the threat through tele-operation of the detection/neutralization suites. Operational speed improvements are achieved through integration of detection sensors, precision neutralizers, and electronic mine marking. Sensors and multiple neutralizer designs were tested in FY99. The detection algorithms were modified and sensor fusion concepts were incorporated. The neutralizer design was optimized for neutralization performance (high probability of kill) and production (size/weight reduction); one design was downselected for further testing in FY00. The MH/K ATD system integration effort provided valuable integration lessons, such as sensor remote-control, operation involvement, and target/vehicle position information. Due to enhanced sensor fusion and automated target recognition (ATR), the probability of detection and mine location accuracy significantly reduces the logistical burden by decreasing the size and number of munitions needed to obtain the high probability of kill required for the MH/K system.

Challenges. Technical barriers include improving upon the demonstrated VMMD ATD’s performance in probability of detection and reduction in false alarms, packaging and demonstrating a precision close-in neutralizer with high probability of kill, integrating the detection and neutralization functions, and accurately marking and delivering the neutralizer.

Milestones/Metrics.

FY2000: Conduct the MH/K ATD using fully integrated detection/neutralization system. Demonstrate enhanced close-in detection capabilities in temperate and arid environments. Demonstrate precision neutralizer’s capabilities in temperate and arid soil environments. Demonstrate common control vehicle's tele-operation of integrated detection/neutralization system.

Customer POC

COL Edward JANASKY, USA
MANCENT

Service/Agency POC

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SARD/TT

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USD(A&T) POC

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ODUSD(S&T)/SS

G.01 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603606A	608	9.6	0.0	0.0	0.0	0.0	0.0
	DTO Total	**9.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

G.06 Rapid Airborne Mine Clearance System ATD

Objectives. The Rapid Airborne Mine Clearance System (RAMICS) ATD will develop and demonstrate the technologies for rapid and effective neutralization of near-surface mines. RAMICS will demonstrate integrated light detection and ranging (LIDAR) targeting, fire control, gun system, and supercavitating projectile technologies on a helicopter to rapidly neutralize near-surface mines.

Payoffs. RAMICS will provide a joint force commander with an organic in-stride capability to rapidly target and destroy near-surface mines with minimum risk to personnel and equipment. Currently, the only means to positively destroy near-surface mines requires the use of mine-/countermeasures-dedicated, remotely operated underwater vehicles or explosive ordnance disposal personnel, which greatly impedes the tempo of joint countermine operations. Low-level funding for RAMICS commenced in FY95. In FY98, several critical tests were conducted that demonstrated projectile lethality (against mines), validated safe standoff distances, and qualified projectile aerodynamic and hydrodynamic stability and gun dispersion. A complete end-to-end simulation of RAMICS was developed and used to develop an error budget for all system components. In FY99, projectile lethality was demonstrated against submerged mines from a static platform.

Challenges. Technical challenges for RAMICS include LIDAR targeting through the modulating air–sea interface, fire control accuracy, aerodynamic and hydrodynamic stability of projectile, projectile impact effectiveness to ensure confirmed mine destruction, and platform dynamics and integration.

Milestones/Metrics.

FY2000: Integrate system components on Cobra helicopter. Demonstrate rapid airborne neutralization of near-surface moored contact mines.

Customer POC

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OPNAV/MIW/EOD

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Service/Agency POC

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USD(A&T) POC

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G.06 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603792N	R1889	7.5	0.0	0.0	0.0	0.0	0.0
	DTO Total	**7.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

G.11 Advanced Mine Detection Sensors

Objectives. Evaluate and demonstrate emerging close-in mine detection technologies with potential for improvements in the probability of detection (P_d), false-alarm rate (FAR), and operational tempo of current and developing mine detection systems; and investigate various technologies including passive microwave, eddy-current-time-domain analysis, high-dynamic-range radar processing, acoustic/laser vibrometer (ALV), giant magneto-resistive sensor (GMRS) arrays, and microbial bioluminescence.

Payoffs. Improvements in P_d and FAR will provide increased operational tempo and operator survivability for the maneuver force when in a mine threat environment. Specifically, these improvements will be applied to the Handheld Standoff Mine Detection System and the Ground Standoff Mine Detection System. Both of these systems are scheduled to enter engineering and manufacturing development in FY99. Improvements in hardware and software will be implemented as product improvements after system fielding. Each of the technologies under investigation will contribute to improved P_d, decreased FARs, or improved capabilities, which directly translates to improved operational tempo or operator/force survivability. In FY98, this DTO completed eddy current decay analysis experiments for surface targets and concluded that this technique has potential to reduce FAR for metal targets; initiated field experiments to confirm laboratory findings; completed fabrication of ALV breadboard; conducted laboratory experiments with targets in sand and collected clutter data in the field; completed hardware fabrication of FM radar transmitter; initiated data collection with commercial off-the-shelf ground penetrating radar and analysis of results; completed fabrication of 1-GHz and 5-GHz passive microwave breadboard; concluded effort with field demonstration and final report successfully cultured bacteria that show potential for TNT auxotrophism; and completed analysis of GMRS array breadboard for potential P_d and FAR improvements in handheld systems. ALV may show potential for P_d and standoff improvements for vehicle application, and FM radar may show potential for FAR reduction for vehicle application.

Challenges. Challenges are to develop (1) techniques that improve clutter rejection capability, (2) robust techniques capable of maintaining high levels of performance in diverse environments, (3) techniques resulting in high P_d for very small, nonmetallic/low-metal-content mines, and (4) techniques that maintain the required P_d/FAR combination at standoff distances greater than 5 m.

Milestones/Metrics.

FY2000: Assemble and test FM radar proof-of-concept breadboard. Initiate engineering of TNT auxotrophic bacteria for bioluminescence. Complete fabrication of GMRS breadboard and conduct proof-of-concept experiments. Demonstrate multisensor ability to detect mines at speeds of 5 to 20 km/hr. Initiate new technology efforts. Leverage DARPA Nuclear Quadrupole Resonance for applications as scanning or confirmation mine detection sensor.

FY2000: Leverage DARPA-developed Nuclear Quadrupole Resonance; build and evaluate a vehicle-mounted mine detection sensor for applications as scanning or confirmation mine detection sensors.

FY2001: Complete proof-of-concept experiments and transition successful technologies to advanced development for maturation prior to insertion as upgrades into current or existing mine detection systems.

Customer POC

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USD(A&T) POC

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G.11 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602712A	H24	3.3	3.8	0.0	0.0	0.0	0.0
	DTO Total	**3.3**	**3.8**	**0.0**	**0.0**	**0.0**	**0.0**

G.12 Lightweight Airborne Multispectral Countermine Detection System

Objectives. Demonstrate an airborne detection system integrated into the tactical unmanned aerial vehicle (UAV) to provide standoff minefield and limited-nuisance mine detection that supports operational planning and tactical maneuvering on the battlefield. The DTO will focus on exploring a variety of new component and focal plane array (FPA) technologies, multi-/hyperspectral imaging, active illumination, passive polarization, passive millimeter wave, foliage penetration, synthetic aperture radar, and electronic stabilization. The USMC will explore technologies for beach/littoral minefield detection. The U.S. Army and USMC will leverage and exchange airborne minefield detection data and will leverage other services/agencies' airborne minefield detection technologies.

Payoffs. The effort will develop and demonstrate technology (lightweight, multispectral sensor technology and minefield detection algorithms) that will provide the capability to perform real-time, accurate detection of minefields from a UAV in a tactical environment. The LAMD capability will generate information to support maneuver planning and real-time maneuver operations.

Challenges. Technical barriers include the robust detection of mines, discrimination of mines from clutter, and system (sensor and processor) weight minimization.

Milestones/Metrics.

FY2000: Initiate development of multispectral algorithms, collect data with testbed sensor to support algorithm development and evaluation, perform a near-term benchmark demonstration, and develop lightweight sensor specifications.

FY2001: Procure/initiate development of lightweight sensor, continue algorithm development and demonstrate improvements, and initiate system integration with UAV.

FY2002: Complete sensor build, continue system integration with UAV, continue algorithm development, and demonstrate improvements.

FY2003: Complete algorithm development, complete system integration with UAV, and conduct subsystem test and demonstration.

Customer POC

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Service/Agency POC

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MARCORSYSCOM/AWT

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G.12 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602131M	R3001	1.3	1.6	1.5	1.5	0.0	0.0
0602712A	H24	1.5	0.0	0.0	0.0	0.0	0.0
0603606A	608	14.6	13.9	9.0	3.6	0.0	0.0
0603640M	R2223	0.0	0.4	1.0	1.0	0.0	0.0
	DTO Total	**17.4**	**15.9**	**11.5**	**6.1**	**0.0**	**0.0**

G.13 Electro-Optic Mine Identification

Objectives. Develop and demonstrate EO undersea sensor technologies to rapidly identify volume, bottom, and partially buried sea mines at extended ranges in highly turbid environments. Mine identification is the last stage in mine hunting prior to neutralization. Current neutralization assets (explosive ordnance disposal divers, SLQ–48) are extremely slow (typically 1 hr per mine-like object), and it is imperative that they not be deployed against false targets. This DTO pursues Steak Tube Imaging LIDAR (STIL) to provide high-resolution 3D images of mines. In addition, image processing and automated mine identification algorithms are developed and demonstrated for use with optical mine identification technologies. These technologies are being developed for surface and airborne organic mine countermeasures.

Payoffs. Underwater mine identification eliminates operational delays associated with unnecessary asset allocations or diversions around objects that are later proven not to be mines. These delays, dependent on clutter density, are quite significant. In one system study, the amphibious operating area took 14 days to clear with current assets, but only 3 days with mine identification assets in place. This dramatic improvement in sea-based mine countermeasure operations will enable quicker force projection and amphibious beach assaults.

Challenges. Challenges for rapid mine identification include maintaining sufficient resolution for identification at operational speeds, 3D imaging, operation in high-ambient-light/high-backscattering environments, optimal display of 3D images in real time, and development of computer-aided detection and identification algorithms to assist the human operator or monitor.

Milestones/Metrics.

FY2000: Demonstrate STIL mine identification technology from ship-based and helo-based tow, including automated identification.

FY2001: Transition to Airborne Mine Countermeasures and Surface Mine Countermeasures program offices.

Customer POC

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CDR Steve LEHR, USN
OPNAV/MIW/EOD

Service/Agency POC

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ONR 322W

USD(A&T) POC

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G.13 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603782N	R2226	4.5	0.6	0.0	0.0	0.0	0.0
	DTO Total	**4.5**	**0.6**	**0.0**	**0.0**	**0.0**	**0.0**

G.14 Automatic/Aided Technology for Detection of Unexploded Ordnance Clearance ATD

Objectives. Develop unexploded ordnance (UXO) detection technology to improve the ability of clearance personnel to detect, locate, access, identify, evaluate, neutralize, recover, and dispose of UXO. This DTO emphasizes the automation technologies needed to support UXO clearance, and will provide scientific understanding, analysis, methodology, and theory to aid in the detection of UXO.

Payoffs. This program will provide improved automatic/aided target detection and recognition algorithms to accomplish robust search, detection, and neutralization of UXO in support of countermine, humanitarian demining, and UXO environmental remediation programs. The fusion of information from existing and new sensors to aid in the detection process will be addressed. This effort will focus on improving algorithms, establishing the standards for testing, modeling UXO data, defining metrics, and evaluating technologies for UXO detection and clearance. Work will leverage ATR efforts for detecting tactical and strategic targets and existing work being performed under DTO SE.19, Affordable ATR via Rapid Design, Evaluation, and Simulation. This DTO will also build on the work started by the DoD integrated product team working groups, and integrate DoD UXO clearance technology activities with other government agencies and international efforts.

Challenges. Current sensors and processing algorithms cannot reliably distinguish UXO targets from background clutter. When viewed with current sensors, locations that are “clean” do not look very different from contaminated sites. This assessment is statistical and is based on actual cleanup data as well as on controlled experiments. Even for objects with ample signal strength, the background clutter prevents distinguishing these objects from UXO targets. There is also tremendous variability in the noise and clutter at different sites, and the clutter densities for objects with large strength signals can be very high. These factors mean that the UXO problem requires an improved ability to discriminate targets from noise and clutter in order to achieve acceptable probabilities of detection and false-alarm rates.

Milestones/Metrics.

FY2000: Continue to incorporate multisensor fusion algorithms for humanitarian demining/UXO clearance to improve probability of detection; increase performance of surface and buried UXO detection (goal: 10X).

Customer POC	**Service/Agency POC**	**USD(A&T) POC**
COL David KINGSTON, USA DCD	Mr. John HODAPP USA/NVESD	Dr. Jasper LUPO ODUSD(S&T)/SS

G.14 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603232D	P232	0.5	0.0	0.0	0.0	0.0	0.0
0603716D	P470	1.5	0.0	0.0	0.0	0.0	0.0
	DTO Total	**2.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

G.15 Very Shallow Water Reconnaissance/Clearance

Objectives. Demonstrate capability of cooperating unmanned underwater vehicles (UUVs) to perform wide-area reconnaissance (search, mapping), lane reconnaissance (reacquisition, verification, marking) and assault lane preparation (lane marking, placement of neutralization charges/command actuators) in the very shallow water (VSW) and surf zone (SZ) environments. This DTO focuses on developing and demonstrating component technologies (sensors, communications, navigation, platforms, control) for the employment of networks of UUVs in pre-assault survey (hydrography, mine/obstacle detection) and battlespace preparation (target and lane marking) in advance of an in-stride amphibious landing force.

Payoffs. In the near term, unmanned systems are expected to augment diver/mammal teams; in the longer term, unmanned systems may replace them. Fused with data from overhead sensors, UUV reconnaissance systems will provide the commander a comprehensive picture of the battlespace. The information will significantly aid in planning for amphibious operations, allowing commanders to avoid heavily mined areas.

Challenges. A major technical challenge is to overcome the adverse effects of the complex SZ and VSW environments on the performance of sensor, communications, and navigation systems and platform dynamics. Other technical challenges include robust network control, positive identification of threat objects, detection of buried mines, LPI/LPD communications (within the network and to/from remote authority), and maintenance of overall low-visibility/clandestine nature of system.

Milestones/Metrics.

FY2000: Develop sensing technologies and the capability to employ sensed information between communicating platforms employing independently acquired sensed data; develop search strategies that are optimized based on information provided by environmental survey data acquired by search and reconnaissance UUVs.

FY2001: Demonstrate and evaluate capability to communicate target information to a control authority; demonstrate asset redirection; demonstrate multiplatform wide-area and lane reconnaissance in the VSW; demonstrate lane reconnaissance in the SZ with bottom platforms.

FY2002: Demonstrate coordinated reconnaissance and lane preparation operations in VSW and SZ; demonstrate deployment of navigation and marking transponders by UUV platforms; demonstrate computer-aided detection and computer-aided classification processing on target data.

Customer POC

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G.15 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603782N	R2226	3.9	4.1	4.0	0.0	0.0	0.0
	DTO Total	**3.9**	**4.1**	**4.0**	**0.0**	**0.0**	**0.0**

M.01 Offboard Augmented Theater Surveillance ATD

Objectives. Demonstrate capabilities to allocate resources and fuse data from multiple sensors to cohesively detect, track, and identify dynamic time-critical targets (TCTs) in real time, greatly improving the comprehensive situation understanding of the battlefield commander. A Ground Moving Target Indication (GMTI) sensor suite will be employed utilizing the Moving Target Exploitation ground and airborne systems. Joint STARS dynamic target exploitation will be improved through the proper coordination of offboard cueing tip-off information, employed with automatic resource control, and correlated with unmanned aerial vehicle (UAV) and space-based platforms.

Payoffs. Resource allocation and fusion algorithms will integrate all-source offboard data with GMTI sensors to localize regions harboring TCTs. Real-time fusion and resource management algorithms will be tailored to optimize coverage schemes for platforms such as Joint STARS, UAVs, and space-based platforms. Advanced modes of GMTI operation will be employed such as high range resolution, RF tagging, motion pattern analysis, and automatic target recognition (ATR). Regions that provide difficulty for single-platform coverage due to terrain masking and dense foliage will be exploited utilizing multiplatform fusion and optimization techniques for platform coverage and scheduling. Resource allocation and sensor fusion will be demonstrated within the GMTI workstation environments. This effort began in FY97 in response to the need to exploit and fuse data from many sources to develop a situational understanding of ground moving targets. The major accomplishments performed from this ATD include the analysis and performance measures of automatic tracking of GMTI data. Automatic tracking algorithms are the enabling technology that leads to the exploitation of GMTI data.

Challenges. The key challenge is to effectively integrate existing and newly developed technologies, both onboard and offboard Joint STARS, to maintain continuous situational awareness and rapidly locate the TCT. Commercially available, high-performance computing processing and multiple sensor fusion feedback and control will demonstrate the integration of advanced technologies to cohesively detect and identify dynamic TCTs.

Milestones/Metrics.

FY2000: Conduct laboratory demonstration of ISR architecture with Broadsword integration, multisource GMTI fusion demonstration with detection and track-level fusion algorithms, and integrated ISR architecture final demonstration with integrated CONOPS.

Customer POC

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Service/Agency POC

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USD(A&T) POC

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M.01 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603789F	4072	1.7	0.0	0.0	0.0	0.0	0.0
	DTO Total	**1.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

M.02 Extending the Littoral Battlespace ACTD

Objectives. Demonstrate an enhanced integrated communications, C^2, sensors, and fire and targeting capability to enable rapid employment, maneuver, and fire support from the sea of dispersed units operating in an extended littoral battlespace (ELB).

Payoffs. This DTO will provide situation awareness, mobile command and control, integrated sensors, responsive fires and targeting, and over-the-horizon (OTH) connectivity through a dynamic information network; enable dispersed units and highly mobile conventional forces to deal with contingencies and serve as a precursor force to deter and halt attacks, secure areas, and prepare for follow-on forces in littoral operations; and provide ship-to-ship networking for C^2 and offloading of critical SATCOM resources.

Challenges. This is a system-of-systems ACTD, relying on mature commercial and government off-the-shelf components. Consequently there are no S&T barriers. However, establishing and maintaining wide-area, high-bandwidth tactical networks and the selection and integration of components into a seamless, functioning architecture with associated tactics, techniques, and procedures is a significant challenge.

Milestones/Metrics.

FY2000: Prepare for major system demonstration II; support deployment and assessment of ELB communications and collaborative planning tools on the Tarawa ARG/13th MEU; refine system architecture for evaluation; refine wireless network and future technology needs; and select systems for the demonstration.

FY2001: Demonstrate in a major systems demonstration in SOCAL (1) OTH wireless IP communications network supporting up to 100 nodes, with distributed C^2 sites, 100 x 200-mile operating area, and demonstration hardware with improved LPI/LPD/LPE/AJ capability; (2) conduct of C^2 functions using distributed assets and personnel, and all levels of information management architecture consistent across all ELB C^2 components; (3) flexible, integrated, distributed, near real-time targeting from multiple platforms and (4) dynamic sensor integration.

FY2002: Conclude Phase II military utility assessment and commence interim capability support.

FY2003: Conclude interim capability support.

Customer POC	Service/Agency POC	USD(A&T) POC
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M.02 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602315N	00000	5.0	0.0	0.0	0.0	0.0	0.0
0603238N	R2145	9.9	14.8	1.0	1.0	0.0	0.0
0603640M	R2362	9.6	9.6	0.9	0.9	0.0	0.0
0603750D	P523	6.4	8.3	5.0	5.0	0.0	0.0
	DTO Total	**30.9**	**32.7**	**6.9**	**6.9**	**0.0**	**0.0**

M.04 Line-of-Sight Antitank System ACTD

Objectives. Develop and demonstrate the military utility of a lightweight, kinetic-energy missile system that provides dedicated long-range antitank fire and high-value, hard-target defeat in support of close combat by light forces during and after forced entry operations. The Line-of-Sight Antitank (LOSAT) ACTD encompasses the development and man-rating of the missile and fire unit; a three-phase battle lab warfighting experiment consisting of a deployability demonstration, survivability demonstration, and lethality demonstration that will be conducted by the user; and a 2-year extended user evaluation by the 82nd Airborne Division that will take place during FY04 and FY05 after the completion of this DTO.

Payoffs. LOSAT will provide enhanced lethality and survivability to early entry forces as an assault support weapon during and after forced entry operations. Given the cancellation of the Armored Gun System and the stand-down of the 3rd Battalion Armored in the 82nd Airborne, early entry forces now have very limited long-range line-of-sight assault capabilities. LOSAT will help fill that gap. Tactical deployability of LOSAT can be by low-velocity airdrop for C–130 or larger aircraft and slingload by CH–47 and UH–60L helicopters, which will allow it to go in with initial early entry forces during forced entry operations. Survivability is increased over current antiarmor systems because of its long engagement range (beyond tank gun range), short time of flight, and increased mobility. High rate of fire and overwhelming lethality will permit LOSAT to serve as a long-range assault weapon to quickly defeat all known and projected threat tanks, including those protected by active protection systems and high-value targets such as bunkers. These capabilities mean that LOSAT can be used to fix the opposing force and permit effective maneuver of shorter range systems as well as help ease the transition from the initial entry forces to the later-arriving heavier forces.

Challenges. Technical challenges are related to system integration and affordability. The weight constraints imposed by the stated user requirement, a fire unit slingload by UH–60L (9,000 lb maximum) while maintaining sufficient survivability, will be the primary challenge. Affordability issues also restrict the use of exotic lightweight materials to meet this challenge. Further challenges include assuring hardware durability in forced entry environments (including airdrop) and optimizing the missile guidance concept to incorporate an inertial measurement unit into the guidance scheme to allow an off-axis launch capability to account for loss of a turret on the fire unit.

Milestones/Metrics.

FY2000: Continue the fire unit and missile hardware designs and begin prototype fabrication.

FY2001: Complete hardware and software design and begin fire unit and missile integration.

FY2002: “Stand-up” LOSAT company in the XVIII Airborne Corps and conduct training and limited operational experiments. Start technical testing. Demonstrate XX% probability of kill at YY m (actual numbers are classified), and low-velocity C–130 airdrop with man-rated system.

FY2003: Conduct lethality live fire tests and force-on-force operations assessment. Provide leave-behind assets.

Customer POC	Service/Agency POC	USD(A&T) POC
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	Mr. Bruce ZIMMERMAN SAAL–TT	Mr. Jack TAYLOR ODDR&E/AT

M.04 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603654A	460	36.8	50.7	57.1	28.2	0.0	0.0
0603750D	P523	3.8	3.8	0.0	0.0	1.0	2.0
	DTO Total	**40.6**	**54.5**	**57.1**	**28.2**	**1.0**	**2.0**

M.04 Non-S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
SSN 11109100	LOSAT MSL	0.0	0.0	9.5	18.1	0.0	0.0
	DTO Total	**0.0**	**0.0**	**9.5**	**18.1**	**0.0**	**0.0**

M.06 Precision-Guided Mortar Munition ATD

Objectives. Demonstrate through simulation and testing of the 120-mm Precision-Guided Mortar Munition (PGMM) the ability to engage, detect, and defeat high-value targets such as earth and timber bunkers, command posts, and logistic sites. The 120-mm PGMM will demonstrate a range of 12 km while maintaining a weight of no more than 40 lb.

Payoffs. The PGMM will provide the infantry with a new capability—the defeat of high-value point targets at ranges beyond 7.2 km. PGMM will be a critical tool for use in stability and support operations (formerly called operations other than war). PGMM will allow commanders to conduct precision strikes while minimizing collateral damage. In addition, PGMM is ideal for use in military operations in urbanized terrain. The mortar's high angle of fire makes it an ideal system to destroy point targets while reducing friendly exposure and casualties.

Challenges. The challenges include strapdown guidance, extended range glide, and extended range delivery accuracy and performance.

Milestones/Metrics.

FY2000: Fire PGMM round (without seeker or warhead) and perform a controlled glide to demonstrate extended-range glide capability (12 km required, 15 km desired) via flight and analysis.

FY2001: Fire PGMM round equipped with strapdown laser detector and hit a laser-designated bunker target to demonstrate precision strike capability via flight and analysis. Integrate GPS/INS performance parameters into lab simulation to measure delivery accuracy.

Customer POC

LTC Douglas LITAVEC, USA
USAIC/ATZB

Service/Agency POC

Mr. John APPEL
SARD/TT

Mr. Matthew CILLI
ARDEC

USD(A&T) POC

Mr. Jack TAYLOR
ODDR&E/AT

M.06 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603004A	43A	9.2	2.9	0.0	0.0	0.0	0.0
	DTO Total	**9.2**	**2.9**	**0.0**	**0.0**	**0.0**	**0.0**

M.09 High-Mobility Artillery Rocket System

Objectives. Develop and demonstrate a lightweight, C–130-transportable version of the M–270 Multiple-Launch Rocket System (MLRS). Mounted on a 5-ton family-of-medium-tactical-vehicles (FMTV) truck chassis, it will fire any rocket or missile in the MLRS family of munitions. The High-Mobility Artillery Rocket System will use the same C^3 and the same crew as the MLRS launcher, but it will carry only one rocket or missile pod.

Payoffs. HIMARS will demonstrate a man-rated cab to protect its crew from rocket exhaust gases and launch debris. It will be fully C–130 transportable, both in weight and in cubage, and will fire rockets and missiles in the MLRS family of munitions. Its automated onboard reload capability and quicker aiming platform movement will provide accelerated mission timelines enabling greater survivability for the warfighter.

Challenges. Technical barriers include developing an accurate aiming platform within weight and height constraints, integrating MLRS-line replaceable units (fire control system, radios, air filtration, etc.) into the space available in the FMTV 5-ton truck cab, and developing a reload system for rocket and missile pods.

Milestones/Metrics.

FY2000: Complete user evaluation and enter EMD in FY2000.

Customer POC

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Service/Agency POC

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DUSD/AS&C

M.09 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603313A	380	1.8	0.0	0.0	0.0	0.0	0.0
	DTO Total	**1.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

M.10 Theater Air and Missile Defense Interoperability ACTD

Objectives. Improve the integrated air picture and extend the effective engagement zones of theater air and missile defense (TAMD) weapon systems, ultimately expanding the warfighter's battlespace. This ACTD is in three phases: a real-time data exchange between the Patriot and Aegis weapon systems via the cooperative engagement capability (CEC); an engage-on-remote (EOR) of a low-altitude surrogate cruise missile using those same systems; and a THAAD/CEC data collection, analysis, and integration investigation. It provides data to extend the Army evaluation of warfighting capabilities. It leaves behind hardware, software, and facilities to evaluate a potential joint composite tracking network architecture and CEC hardware-in-the-loop family of systems interoperability that could lead to future fielded operational capabilities.

Payoffs. This ACTD will increase the TAMD defended area, improve the single integrated air picture (SIAP), and increase our capability to conduct contingency operations. It will address the following warfighter needs: SIAP/common operational picture, greater tactical datalink capability, minimal data latency, combat ID (CID), elimination of multiple tracks and incorrect CID, faster warnings, precise cueing, and beyond-line-of-sight engagement capability. It will also improve robustness against countermeasures, sensor losses, and defense suppression attack when overlapping coverage exists; enhance coordination among shooters and associated command and control nodes; enhance combat identification of detected airborne objects; and create opportunities to employ integrated fire-control concepts such as EOR and forward pass.

Challenges. Technical barriers include SIAP/common operational picture, tactical datalink capacity, data latency, combat identification of potential threats, multiple tracks, incorrect combat identification, warning and cueing time, and beyond-line-of-sight engagement capability.

Milestones/Metrics.

FY2000: Demonstrate a capability to utilize multiple Aegis sensors (and possibly Marine Corps TPS–59) data to engage a low-altitude surrogate cruise missile with a Patriot PAC–3 using CEC composite air picture track and measurement data as part of the Patriot Phase II EOR live fire demonstration in September 2000.

FY2001: Conduct post-test analyses to demonstrate the benefits of THAAD sensor measurement and track data to the CEC network, as part of the THAAD additional user test planned for the 1st Quarter, FY2001.

FY2002: Commence interim capability support in Huntsville, AL.

FY2003: Conclude interim capability support.

Customer POC	**Service/Agency POC**	**USD(A&T) POC**
CDR Hugh COOK, USN USACOM/J611	LTC Ted KOUFAS, USA BMDO/TOS	Mr. Jack TAYLOR ODDR&E/AT
		Dr. Rick WALLACE DUSD/AS&C

M.10 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603750D	P523	5.1	4.0	0.4	0.4	0.0	0.0
	DTO Total	**5.1**	**4.0**	**0.4**	**0.4**	**0.0**	**0.0**

M.10 Non-S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603873C	3261	10.1	5.2	0.0	0.0	0.0	0.0
	DTO Total	**10.1**	**5.2**	**0.0**	**0.0**	**0.0**	**0.0**

M.11 Common Spectral MASINT Exploitation ACTD

Objectives. Demonstrate measurement and signal intelligence (MASINT) and common spectral measurement exploitation capability (COSMEC) end-to-end tactical utility of MASINT spectral analysis to the warfighter. This demonstration will establish COSMEC's ability to support the Joint Vision 2010 mission areas of Information Superiority and Combat ID, and will also address specific CINC operational requirements.

Payoffs. The COSMEC workstation is a Windows NT- or Unix-based workstation providing MASINT spectral processing and exploitation capability to analysts in preparation for government and commercial multi-/hyperspectral collection platforms. It supports both tactical and strategic intelligence using state-of-the-art MASINT processing and exploitation algorithms. These algorithms will enhance the U.S. spectral data exploitation capability. COSMEC has the ability to support a variety of operational requirements, including detection and identification of camouflage and vehicles, search and rescue, terrain characterization and mapping, beach route preparation, submarine detection, and detection of chemical/biological weapons. COSMEC will provide operational units with the capability to exploit data from existing and planned spectral sensors like (e.g., LANDSAT, SPOT, SYERS P^3I, TRIPS, and LASH). The modular design of COSMEC will make the process of updating the program with new algorithms or sensors, such as warfighter and NEMO, very simple. This COSMEC ACTD demonstration will establish the capability of multi-/hyperspectral analysis in real-time aboard an airborne platform, as well as exploitation in the Joint Analysis Center. The system will be evaluated during CONUS joint exercises and support current military operations in the EUCOM theater.

Challenges. Technical barriers include the ability to detect and identify threat vehicles under camouflage, distinguish between friendly and threat forces, precisely identify material, detect downed aircraft and pilots, remotely characterize terrain, support beach route preparation, detect submarines and unmanned undersea vehicles, remotely determine trafficability of terrain, and most effectively exploit the data available from existing spectral sensors in support of other joint warfighting needs.

Milestones/Metrics.

FY2000: The utility of spectral data will be demonstrated with operational assets, such as SYERS/CARS or LANDSAT/Eagle Vision, during a theater-level exercise like Foal Eagle, Union Flash, or Trail Blazer.

FY2001: Commence interim capability support, software support, and training at PACOM and EUCOM.

FY2002: Conclude interim capability support, software support, and training at PACOM and EUCOM.

Customer POC	**Service/Agency POC**	**USD(A&T) POC**
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Mr. Diego RAMOS, USA USSOUTHCOM		Dr. Rick WALLACE DUSD/AS&C

M.11 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603750D	P523	1.3	1.4	0.1	0.0	0.0	0.0
	DTO Total	**1.3**	**1.4**	**0.1**	**0.0**	**0.0**	**0.0**

M.11 Non-S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0301135F	RCCC	7.0	2.0	2.0	0.0	0.0	0.0
	DTO Total	**7.0**	**2.0**	**2.0**	**0.0**	**0.0**	**0.0**

M.12 Load Carriage Optimization for Enhanced Warfighter Performance

Objectives. Develop biomechanical methods and data, design guidance, physical training regimens, and predictive analytical models to address the human locomotion and load-bearing functions of the soldier system in order to enhance mobility, increase stamina, and maximize overall troop performance.

Payoffs. The outcomes of this effort will be (1) a database of experimentally derived knowledge of the load-bearing capabilities of military personnel transitioned to soldier models for simulation-based acquisition; (2) load-carriage components compatible with the physical requirements of military personnel; and (3) a predictive, physics-based model that enables the design of clothing and equipment that optimize the soldier's energy consumption, load distribution, and ground mobility. The articulated total body modeling capabilities at the AF Armstrong Labs will be leveraged in this effort. The ultimate payoff will be to make load carriage less stressful and to produce changes in performance that are equivalent to those that would be produced by actual reductions in weight without sacrificing mission load requirements.

Challenges. The absence of detailed biomechanical data, scientifically derived design principles, and models of movement severely limits current efforts to optimize troop load carriage. The technical challenge is to develop robust methods to provide an empirical database of the biomechanical forces operating on the human body under various loads, rates of movement, training conditions, and terrain; and to develop a physics-based model of human locomotion in order to design load-carriage gear that improves the mobility of ground troops.

Milestones/Metrics.

FY2000: Quantify the effects of load-carrying gear, clothing, and individual equipment configured for specific squad positions on human performance. Complete passive–dynamic gait model.

FY2001: Determine effects of varied topographic and terrain conditions. Extend the passive–dynamic gait model to encompass terrain data.

FY2002: Provide design guidance for load-carrying equipment that enhances mobility performance across squad positions by 15%.

FY2003: Demonstrate that physical training programs improve locomotor performance by 15%. Provide physics-based model to equipment developers.

Customer POC	Service/Agency POC	USD(A&T) POC
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COL Henry KINNISON, USA TRADOC		
Maj Gabe PATRICIO, USMC SBCCOM		

M.12 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602786A	H98	1.0	1.2	1.3	1.4	0.0	0.0
0602787A	879	0.1	0.1	0.1	0.1	0.0	0.0
	DTO Total	**1.1**	**1.3**	**1.4**	**1.5**	**0.0**	**0.0**

M.13 Hypersonic Weapons Technology Demonstration

Objectives. By FY03, demonstrate the enabling technologies for a class of hypersonic strike weapons. Specifically, the objectives are to demonstrate critical technologies in the areas of propulsion, airframe, ordnance, and guidance and control that will allow for hypersonic strike weapons with an average velocity of Mach 5–6, a range of 400–700 nmi, that cost less than $400,000 a unit, have a CEP of less than 3 m, and that deliver ordnance that penetrates 18–36 ft of concrete.

Payoffs. Hypersonic weapons can be air- or surface-launched and can be used to effectively and efficiently destroy time-critical targets, such as mobile missile launchers and mobile command and control posts; heavily defended targets, such as C^3 nodes, leadership sites, and strategic surface-to-air missile and theater ballistic missile sites; and hardened targets, such as aircraft shelters, weapons of mass destruction facilities, and deeply buried targets. The technologies developed and demonstrated in this DTO will allow for initiation of acquisition activities for an affordable hypersonic strike weapon.

Challenges. The major technology challenges of this DTO involve developing high-aerodynamic-efficiency airframes capable of carrying large payloads at long ranges that are compatible with both Vertical Launch System and aircraft carry. The propulsion challenges involve developing and demonstrating high-specific impulse engines for long range with high thrust for high speed, and that are capable of being throttled but allow continuous thrust for terminal maneuvers. For ordnance, the significant challenges are development of a warhead/case structure capable of surviving Mach 4+ ground penetrations. Guidance and control challenges include identifying and demonstrating thermal mitigation techniques for IR/RF windows and domes, low-drag control systems, and affordable IR/RF terminal seekers capable of operation in a high-thermal environment.

Milestones/Metrics.

FY2000: Demonstrate Mach 4 penetrator capability.

FY2001: Conduct free-jet test of axisymetric dual-combustion ramjet engine configuration.

FY2002: Demonstrate Mach 6 penetrator warhead design.

FY2003: Demonstrate guidance and control thermal mitigation techniques; and conduct free-jet test advanced engine integrated with advanced blended body airframe configuration.

Customer POC

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Service/Agency POC

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ONR

USD(A&T) POC

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M.13 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602111N	00000	3.8	3.9	3.2	2.0	0.0	0.0
0603217N	R0447	4.7	5.8	8.8	7.0	0.0	0.0
	DTO Total	**8.5**	**9.7**	**12.0**	**9.0**	**0.0**	**0.0**

M.14 Artillery-Launched Observer Round ATD

Objectives. The Joint Artillery-Launched Observer Round (ALOR) is comprised of two programs: the Army QuickLook program and the Navy's Forward Air Support Munition (FASM) Fleet Advanced Demonstration program. Both of these programs have agreed to cooperatively demonstrate critical technologies required to develop an organic, expendable artillery-gun-fired projectile, which after launch reconfigures to a powered cruise vehicle capable of providing organic targeting, battle damage assessment (BDA), communications relays, and in the case of FASM, munitions delivery. Organic, as used herein, is defined as a releasable, expendable asset available to the ship's fire control commander or brigade fire support officer. ALOR vehicles will transition after gun launch from a supersonic projectile into a winged, low-speed (80–120 knot), medium-endurance (15–180 min) loitering vehicle carrying integral image-based sensors and communications. This low-speed loitering configuration will enable man-in-the-loop imaging, targeting, target identification, BDA, and overhead communications relay for forward-deployed observers. ALOR is structured to meet clearly identified shortfalls in Army, Navy, and Marine Corps artillery fires capabilities to support targeting, accurate responsive fires, and BDA requirements for operational maneuver-from-the-sea and land-attack warfare.

Payoffs. The BDA, limited targeting, and communications relay that ALOR will provide can significantly increase Army, Navy, and Marine Corps fire support capabilities. Specifically, the planned ALOR program provides (1) C^4I and targeting capabilities for fire support for all existing artillery-gun-equipped units and ships using 155-mm or 5-in naval guns; (2) gun-hardened and tested integral BDA capability and limited target location; (3) methods to provide subsequent munitions delivery overcoming localized GPS jamming or target errors; (4) communications relays linking forward-deployed units; and (5) man-in-the-loop BDA and target identification. In addition the Navy FASCM program will demonstrate multiple target and target-type kills per vehicle; lower cost per soft-target kill set at greater ranges than any existing fire support system; less than 2-minute response times from target detection to target kill at +200 nmi from ship launch platforms; the capability to carry wide varieties of lethal, nonlethal, smoke, illumination sensors or other payloads with pre- and post-delivery video of the target area; and overhead communications relay for distant collection points (single inert design demonstrated in FASM).

Challenges. The primary risks are (1) design and operation of a transformable airframe with extendable wing and aero-surface components that can survive gun launch and projectile speeds of Mach 2.0, deceleration, and controlled flight during control surface inflation; (2) design and operation of transformable flexible airframe components maintaining adequate stability, maneuverability, and control over the entire flight envelope; (3) development of inexpensive strapdown sensors and communication subsystems that achieve required targeting/location performance using low-cost, commercial off-the-shelf components and leveraged industry integration practices; and (4) design and operation of a low-cost, high-performance propulsion system that survives gun launch and meets cruise/loiter endurance requirements. A comprehensive Joint Army/Navy risk-management approach will be structured so as to reduce these risks and minimize the potential for subsystem failures. ALOR projectiles will be developed so as to enable rapid transition through FASM and QuickLook EMD programs into production with a design that (1) maximizes compatibility with existing Army, Navy and Marine Corps systems, and (2) minimizes production costs.

Milestones/Metrics.

FY2000: Aerodynamic test airframe manufacture and checkout.

FY2001: Aerodynamic test flight vehicle tests complete; hardware-in-the-loop testing begins; ground control and flight vehicle software design review; cruise performance test vehicle flight demonstration; and g-hardened subcomponent and subsystem tests complete.

FY2002: Gun-launch flight vehicle flight demonstration, targeting accuracy demonstration, and munition delivery demonstration.

Customer POC	Service/Agency POC	USD(A&T) POC
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CAPT Dennis MORRAL, USN NAVSEA, PMS–429	Mr. Stephen PEARCY, USA TACOM/ARDEC	

M.14 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602120A	H16	0.0	0.1	0.0	0.0	0.0	0.0
0602303A	214	1.2	0.6	0.5	0.0	0.0	0.0
0602618A	H80	0.7	0.8	0.0	0.0	0.0	0.0
0602624A	H18	1.1	1.6	2.0	0.0	0.0	0.0
0603238N	R2145	4.7	5.1	5.3	0.0	0.0	0.0
	DTO Total	**7.7**	**8.2**	**7.8**	**0.0**	**0.0**	**0.0**

M.15 Future Combat System

Objectives. Develop an integrated multifunctional, multimission network-centric combat fighting system that is strategically deployable anywhere in the world in brigade-sized sets within 96 hours. The Future Combat System (FCS) will demonstrate the ability to conduct a wide range of military activities and operations, from deterring large-scale aggression, to participating in smaller-scale contingencies, to dealing with asymmetric threats like terrorism, information operations, and nuclear, biological or chemical environments. An FCS-equipped force will be capable of joint interoperability; strategic transportability; and conducting all necessary direct fire, indirect fire, air defense, reconnaissance, troop transport, mobility, counter mobility, and nonlethal missions on the future battlefield.

Payoffs. FCS will make the U.S. Army's ground combat forces strategically and tactically relevant on the future battlefield. It will provide our political leaders the ability to deter the use of violence for political purposes by establishing a credible combat force that can be deployed into any theater of operation in as little as 96 hours from the decision to execute such a mission. These forces will be capable of forestalling or redressing any combat aggression threatening U.S. or allied interests around the world. It will provide the combat power necessary to terminate any conflict on favorable terms by deceiving, delaying, disrupting, neutralizing, or destroying hostile land forces. It will enable decisive fires and dominant maneuver on land. The technology package will provide revolutionary lethality overmatch through incorporation of advanced direct, indirect, and air defense modules. It will significantly improve mobility by integrating advanced propulsion technologies such as electric drive/suspension, hybrid electric power, or fuel cells/reformers. It will reduce the force's logistical/sustainment demand by as much as 60% by effectively integrating technologies to reduce platform size, weight, fuel consumption, and manning requirements, and to increase commonality of components across the force. FCS will increase onboard training and battle rehearsal capability embedded in vehicle electronics. Finally, FCS will provide revolutionary survivability through the use of innovative lightweight armors, active protection systems, signature management, and vehicle structure.

Challenges. The major technical challenges are the development of an adequate command and control system allowing for the distribution of the major combat functions on a combination of manned and unmanned combat platforms. This command and control system will have to be coupled with an integrated sensor array that creates a highly reliable and timely picture of the battlefield for all soldiers as they execute their missions. Another challenge will be the optimization of a modular design capable of incorporating and integrating high-payoff leap-ahead technologies. Such technologies might include, but will not be not limited to robotics; electric drive; fuel cells; explosively formed projectiles; small, lightweight, highly lethal missile systems; loitering missiles; electromagnetic guns; advanced armor packages; active protection systems; low-observable technologies; survivability; and embedded simulation systems. Finally, all of the components of the FCS must be fault tolerant and modularized for commonality to significantly reduce the number of components necessary to sustain the force.

Milestones/Metrics.

FY2000: Complete initial concept design. Design concept awards will be made to multiple contractor teams to facilitate competition for ideas. Contractors will initiate building-limited virtual prototypes of their systems so that a force-level evaluation of their concepts can be performed.

FY2001: Industry teams will complete their concept design phase. Contractors will finalize the limited virtual prototype of their systems for force-level performance evaluations. The government will evaluate the force-level capabilities of each contractor's design and downselect to the two best concept designs.

FY2002: Remaining concepts will develop detailed virtual prototypes of their systems and will start the development of selected high-risk/high-payoff technology carriers to demonstrate the feasibility of their designs.

FY2003: Develop virtual testbed prototypes—100% performance modeling and simulation (M&S). Demonstrate performance effectiveness via M&S. Continue the development of selected technology carriers.

FY2004: 100% virtual prototype will be used in conjunction with technology carriers to perform final demonstration of the concept and allow for final evaluation of the proposed design concept.

FY2005: Downselect to a single design and prepare for final entry into acquisition process by completing a formal Milestone I.

Customer POC

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Service/Agency POC

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TACOM/TARDEC

MAJ James PARKER, USA
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DARPA/TTO

USD(A&T) POC

Mr. Jack TAYLOR
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M.15 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602601A	H91	0.6	0.0	0.0	0.0	0.0	0.0
0602601A	HH7	0.0	7.8	19.6	0.0	0.0	0.0
0603005A	440	5.9	35.8	61.6	146.5	161.1	150.9
0603739E	MT–04	3.0	0.0	0.0	0.0	0.0	0.0
0603764E	LNW–01	6.9	20.0	16.9	6.5	0.0	0.0
	DTO Total	**16.4**	**63.5**	**98.1**	**153.0**	**161.1**	**150.9**