Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Office of Secretary Of Defense											Date: March 2014	
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603941D8Z / *Test and Evaluation/Science and Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	96.622	84.112	83.255	81.148	-	81.148	83.117	86.327	91.156	98.832	Continuing	Continuing
1: *High Speed Systems Test*	23.016	12.615	18.953	21.690	-	21.690	27.070	20.978	14.889	16.370	Continuing	Continuing
2: *Spectrum Efficient Technology*	9.742	8.315	7.055	7.441	-	7.441	7.222	7.637	9.020	9.649	Continuing	Continuing
3: *Electronic Warfare Test*	19.127	18.827	15.569	8.172	-	8.172	9.971	12.573	15.105	16.564	Continuing	Continuing
4: *Advanced Instrumentation Systems Technology*	10.025	8.570	10.036	11.610	-	11.610	10.066	9.779	11.530	13.704	Continuing	Continuing
5: *Directed Energy Test*	11.235	11.284	7.252	5.786	-	5.786	4.844	6.430	7.713	8.002	Continuing	Continuing
6: *Netcentric Systems Test*	20.072	16.590	14.518	16.658	-	16.658	12.931	9.834	10.756	10.344	Continuing	Continuing
7: *Unmanned and Autonomous System Test*	3.159	5.273	5.918	5.024	-	5.024	4.621	9.155	10.636	11.252	Continuing	Continuing
8: *Cyberspace Test*	0.246	2.638	3.954	4.767	-	4.767	6.392	9.941	11.507	12.947	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

The Test and Evaluation/Science and Technology (T&E/S&T) Program seeks out and develops test technologies to stay in pace with evolving weapons technologies. This program is critical to ensure that the Department of Defense (DoD) has the ability to adequately test the advanced systems that will be fielded in the future. To meet this objective, the T&E/S&T Program performs the following activities:

- Exploits new technologies and processes to meet important test and evaluation (T&E) requirements.
- Expedites the transition of new technologies from the laboratory environment to the T&E community.
- Leverages industry advances in equipment, modeling and simulation, and networking to support T&E.

Additionally, the T&E/S&T Program examines emerging T&E requirements resulting from Joint Service initiatives to identify T&E technology needs and to develop a long-range roadmap for technology insertion. The program leverages and employs applicable applied research efforts from the highly developed technology base in DoD laboratories and test centers, other government agencies, industry, and academia to accelerate development of new test capabilities. This program provides travel funds for T&E/S&T program oversight, special studies, analyses, and strategic planning related to test capabilities and infrastructure.

The DoD established seven strategic science and technology (S&T) investment priorities: 1) Data to Decisions, 2) Engineered Resilient Systems, 3) Cyber Science and Technology, 4) Electronic Warfare/ Electronic Protection, 5) Counter Weapons of Mass Destruction, 6) Autonomy, and 7) Human Systems. The T&E/S&T Program has been aligned and prioritized to prepare the T&E community to test warfighting capabilities that emerge from these S&T priority investments.

The T&E/S&T Program is funded within the Advanced Technology Development Budget Activity because it develops and demonstrates high payoff technologies for current and future DoD test capabilities.

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Office of Secretary Of Defense	Date: March 2014
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603941D8Z *I Test and Evaluation/Science and Technology*

B. Program Change Summary ($ in Millions)	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	92.602	92.508	94.264	-	94.264
Current President's Budget	84.112	83.255	81.148	-	81.148
Total Adjustments	-8.490	-9.253	-13.116	-	-13.116
• Congressional General Reductions	-	-0.053			
• Congressional Directed Reductions	-7.606	-9.200			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	1.164	-			
• SBIR/STTR Transfer	-2.048	-			
• FY 2015 Adjustment	-	-	-13.116	-	-13.116

Change Summary Explanation

- Strategic efficiency reductions in management headquarters funding and staffing for better alignment and to provide support to a smaller military force.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense			Date: March 2014
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	Project (Number/Name) 1 / *High Speed Systems Test*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
1: *High Speed Systems Test*	23.016	12.615	18.953	21.690	-	21.690	27.070	20.978	14.889	16.370	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

High-speed/hypersonic weapons are being developed to ensure the continued military superiority and strike capability of the United States including freedom of movement and freedom of action in areas protected by anti-access/area denial defenses. Current weapon system demonstrations and technology development programs include high-speed and hypersonic air-breathing missiles, maneuvering reentry and boost-glide weapons, hypersonic gun-launched projectiles, and air-breathing space access vehicles. These systems require development of conventional and high-speed turbine, ramjet, scramjet, and combined cycle engines; high temperature materials; thermal protection systems (TPS); and thermal management systems.

The High Speed Systems Test (HSST) project addresses test technology needs including propulsion, aerodynamic and aerothermal testing, so the test community has the technology to support the required test scenarios for concepts under development in the science and technology (S&T) community. The technology developments within the HSST project align with the Department of Defense (DoD) S&T priority investments. As such, the HSST project is developing, validating and transitioning advanced test and evaluation (T&E) technologies for ground test, open-air range flight test, and advanced computational tools, along with instrumentation and diagnostics systems for use in both ground tests and flight tests of high speed systems.

The HSST project develops technologies to enable robust, accurate, and timely T&E of these future weapon systems. DoD acquisition regulations require weapon systems to undergo a thorough T&E process to detect deficiencies early and to ensure system suitability and survivability. However, the extreme environments in which these weapons operate preclude accurate determination of their performance and operability with today's T&E assets. Current national test capabilities have deficiencies in data accuracy, flight condition replication and simulation, test methods, productivity, modeling and simulation (M&S) fidelity, and range safety.

The HSST mission is to address these national test capability gaps by providing test technology solutions that will enable high-speed and hypersonic weapon systems to be successfully developed through accurate, robust, and efficient T&E.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: High Speed Systems Test	12.615	18.953	21.690
FY 2013 Accomplishments: The HSST project continued to advance ground and flight test technologies, techniques, instrumentation and M&S capabilities required for the development of high speed air-breathing propulsion and boost/glide weapons. Important progress was made toward addressing the two most significant technology shortfalls in current hypersonic aero propulsion ground test capabilities: clean air heat addition (i.e. non-vitiated air) and variable Mach number capability. Current production ground test facilities could only create the high temperature inlet conditions necessary for scramjet engine tests by burning fuel in the airflow prior to entering the engine. As demonstrated by HSST FY 2011 tests, the resulting "vitiated air" had different gas properties than clean air and was not representative of what the vehicle would experience during flight. This significantly affected the engine's performance and operability in the test environment resulting in erroneous flight performance			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 1 / *High Speed Systems Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
predictions. Variable Mach number capability is required to "fly the mission" and determine the critical transient operability effects throughout the flight envelope. Incorporation of component technologies, previously developed by the T&E/S&T program, were initiated into a small-scale, clean air, true temperature, variable Mach number 5-8 aero propulsion test facility. Completion of this facility will demonstrate component technologies have reached Technology Readiness Level (TRL) 6, provide an on-going test asset to the DoD, and reduce risk for construction of a full-scale facility. Significant progress was made this year in Phase I of the facility development including the completed installation of the clean air regenerative storage heater, associated support systems, instrumentation and controls required for facility operation. Design efforts for subsequent phases progressed including the critical design of the air delivery system and preliminary design of a variable Mach number nozzle. Another FY2013 effort examined the incorporation of advanced morphing ceramic materials into the design of common facility nozzle and ducting hardware to achieve a variable Mach number capability and variable inlet distortion patterns representative of flight-like inlet systems. This capability reached critical design and promises to provide a significant advantage over current rigid, stationary facility hardware by providing a "first-ever" realistic variable Mach flight distortion simulation test capability, while reducing test cost and increasing productivity. Ground test accomplishments included continued progress in determining the capability of existing ground test facilities and methodologies to evaluate and develop large-scale hypersonic propulsion systems. Following the successful completion of the benchmark freejet test series utilizing an advanced hydrocarbon fueled missile scale scramjet in a larger facility, the semi-freejet and direct-connect test configurations were initiated in a smaller facility. The resulting analysis comparing tests between the larger and smaller facilities will allow the optimized utilization of existing facilities. In addition this effort will help define the size and type of investments needed for future large-scale scramjet vehicle development and reduction of flight test and acquisition risks. The hypersonic community's first rigorous assessment of data uncertainty was completed on the freejet test series per the US National Standard on measurement uncertainty, which will serve as a precedent for future high-speed propulsion system development. Another task was initiated to examine the unique and extensive set of ground and flight test data collected by the X-51 program so that it can be utilized in the development of state-of-the-art techniques for high speed engine design, development and testing. The HSST project initiated an effort to address critical arc heater technologies and flow quality gaps; this development will improve the service lives of the electrodes and improve nozzle flow quality. Improved computational and numerical simulation models were completed involving magnetic field and arc column interactions with the air flow in the heater necessary to investigate advanced designs and allow for time/memory efficient parallel computing of the simulations. The autonomous flight safety technology was matured to TRL 6 and prototype units were designed and delivered for service certification onboard two Operationally Responsive Space Office flight tests. Another flight test technology effort completed the successful development and programing of advanced parameter identification maneuvers into the flight computer of the fourth X-51 flight. Subsequent analysis of these optimized test maneuvers demonstrated the ability to collect substantially more stability and control data per flight than is possible using traditional methods, thus reducing the number of flight tests and costs for future development systems. Progress was also made in advanced high speed system ground and flight test instrumentation. The initial phase was completed on a ground based, portable Light Detection and Ranging (LIDAR) system to measure atmospheric conditions (density,			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 1 / *High Speed Systems Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
temperature, pressure, wind speed/direction, O2 content) along a hypersonic vehicle's flight path from altitudes of 60k to 250k feet. This initial phase demonstrated the ability to measure these conditions using the LIDAR system at the GroundWinds facility in Mauna Loa, Hawaii at altitudes representative of hypersonic vehicle flight trajectories. This capability will be a significant advancement over current technologies, improving the accuracy of determining atmospheric conditions at high altitudes needed for assessing the performance and operability of air-breathing missiles and boost-glide vehicles during development. A project was initiated to develop a force balance system with high stiffness and frequency response to make measurements in hypervelocity flows with test times of 1-2 milliseconds. This will substantially increase the accuracy of high Mach force measurements that are required to evaluate and improve models of air chemistry in design and prediction codes. An advanced system to measure gas properties in high speed flows was constructed utilizing lasers operating in the mid-infrared spectrum. This system, which significantly lowers gas property measurement uncertainty, was transitioned to a DoD ground test center and a DoD research laboratory. A miniaturized, temperature-compensated wind tunnel balance for supersonic store separation testing was constructed and transitioned. Design, fabrication and demonstration of a non-intrusive laser hygrometer and a non-intrusive optical mass flow measurement system were completed. Testing of a fiber optic heat flux gauge and a high temperature shear stress sensor were also successfully completed. Advances were achieved in the development of a state-of-the-art validated computational M&S tools. An advanced three-dimensional boundary layer transition code and hypersonic nozzle Characteristics Based Grid Generation code have been developed and transitioned to the hypersonic community for beta testing. Recent wind tunnel and flight tests have provided data demonstrating that a fully three-dimensional flow boundary layer stability and transition prediction code is an essential engineering tool needed to evaluate and predict boundary layer instability and transition on maneuverable boost-glide vehicles currently under development by the DoD. Computed tomography methods for optical absorption measurements were completed; these create two-dimensional spatial maps of exhaust gas properties from multi-line-of-sight Tunable Diode Laser Absorption Spectroscopy (TDLAS) measurements for verifying computational fluid dynamics (CFD) code predictions and for determining combustion efficiency for turbine and scramjet engines. This capability will greatly increase the diagnostic value of measurements from miniature, robust TDLAS gas diagnostic sensor systems now routinely used for engine ground and flight testing			
FY 2014 Plans: New test technology efforts will be initiated addressing: test technologies, techniques, and methods to determine full-scale propulsion system performance and operability from subscale tests; technology for improved TPS ablation and weather effects characterization; further development of M&S codes for accurate prediction of flow fields, boundary layer transition, and heat transfer in high-speed flow; new and more accurate instrumentation systems; and application of advanced test technologies to meet other needs such as gas turbine engines, and electromagnetic rail guns. The clean-air, variable Mach number demonstration facility will continue to develop and demonstrate air delivery system technologies to provide uniform flow with variable pressure and temperature from multiple air sources through a fixed nozzle up			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 1 / *High Speed Systems Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
to Mach 8 conditions. The project activities will include completion of the Phase 1 system checkouts and activation of the clean air regenerative storage heater technology. Scramjet ground tests in semi-free jet, and direct connect test modes will be concluded and compared to free-jet test results to quantify their respective accuracies and identify optimal test methods for larger, next generation scramjet engines. Vitiation effects data will be collected to increase the high speed systems community's knowledge base. Ceramic morphing components suitable for missile-scale high speed ground test facilities will be designed and fabricated to maintain well-conditioned flow while varying the flight Mach number and inlet distortion levels. Improved arc jet facility spin coil designs will be advanced enabling improved T&E of maneuvering reentry and boost/glide vehicles. The ground based LIDAR atmospheric sensing system will begin conversion into a mobile platform to support various flight test programs at multiple flight ranges. Verification and improvement of CFD codes will continue, making use of the unique data sets obtained from the HSST scramjet engines tests described above. A boundary layer transition prediction tool for 2-dimensional and axisymmetric bodies will be enhanced allowing for application to complex, 3-dimensional boost-glide vehicle geometries. ***FY 2015 Plans:*** FY 2015 will see continued efforts to improve hypersonic ground and flight test capabilities to levels required for acquisition programs. Efforts will include demonstration of new flight test techniques, improvements in instrumentation, and continued validation and improvement of CFD codes. Progress will continue toward final integration and operation of the clean-air, variable Mach number aeropropulsion facility, including completion of the variable Mach number nozzle design and preparations to demonstrate the capability to simultaneously vary stagnation pressure, temperature and Mach number from 4.5M-7.5M. Design, manufacture, and delivery of a full scale ceramic morphing device for use in a DoD high speed ground test facility will be completed.			
Accomplishments/Planned Programs Subtotals	12.615	18.953	21.690

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 1 / *High Speed Systems Test*

E. Performance Metrics

Percentage of T&E/S&T projects progressing satisfactorily toward technical, financial, schedule, and risk mitigation goals.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense			Date: March 2014
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	Project (Number/Name) 2 / *Spectrum Efficient Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
2: *Spectrum Efficient Technology*	9.742	8.315	7.055	7.441	-	7.441	7.222	7.637	9.020	9.649	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

Weapon systems have become increasingly complex in recent years, resulting in the need for significantly more data to be passed among these systems, and between the systems and our test infrastructure. A vast amount of data must be collected, transmitted, and analyzed, which requires a large amount of radio frequency (RF) spectrum resources. However, the amount of RF spectrum designated to support test and evaluation (T&E) is decreasing, most notably due to reallocation of spectrum for commercial use. The combination of decreasing RF spectrum and increasing data requirements results in an urgent need to create test technologies that maximize the use of spectrum resources for Department of Defense (DoD) T&E operations.

The L and S frequency bands are the traditional spectrum allotted for military use. The explosive need for spectrum in the commercial sector has resulted in reallocation of portions of these bands to industry. To compensate, DoD is now authorized to use the C-Band spectrum which offers numerous benefits, including a three-fold increase in available bandwidth, but C-Band comes with technical challenges. Most notably, our current test infrastructure for telemetry is not designed to accommodate C-Band. Technologies are required to implement innovative techniques that efficiently facilitate our use of C-Band without a major overhaul to our national test infrastructure. For instance, commercial telemetry transmitters operate in C-Band but do not have the form factor (size and weight) or rugged packaging to survive airborne test applications.

Traditional telemetry applications employ streaming telemetry where data is moved one-way from the instrumented system under test to our test infrastructure. Modern network based telemetry capabilities, like those being developed by the Central Test and Evaluation Investment Program (CTEIP) integrated Network Enhanced Telemetry (iNET) effort, enable more robust, efficient bidirectional transfer of data. DoD's strategy is to create technologies for streaming telemetry capability in C-Band while opening up legacy L- and S-Bands for networked telemetry.

The Spectrum Efficient Technology (SET) project is developing test technologies that enable more efficient use of legacy telemetry bands and expansion into non-traditional areas of the RF and optical spectra at DoD test ranges. The technology development efforts within the SET project have been prioritized to align with Department of Defense guidance on science and technology priority investments. As such, the SET project is focusing on growing data requirements of warfighting systems and the limited availability of spectrum for testing. The SET project is structured to develop test technologies to advance range communications, networked telemetry capabilities, and enhanced management of spectrum at DoD test ranges.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Spectrum Efficient Technology	8.315	7.055	7.441
FY 2013 Accomplishments: The SET project developed technologies to meet networked telemetry requirements and performed risk reduction for CTEIP telemetry improvement projects including a networked data recorder to provide risk reduction in support of the CTEIP iNET development. Technology enabling the dynamic reconfiguration of transmitted test data over a telemetry network was further matured. Technology to improve the efficiency of a telemetry network utilizing the advanced Shaped Offset Quadrature Phase			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 2 / *Spectrum Efficient Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015

Shift Keying (SOQPSK) modulation scheme continued. Development of a multi-band transceiver operating in the L/S/C-Band spectrum employing multiple advanced waveforms continued.

The SET project investigated techniques to expand telemetry operations into non-traditional spectrum bands by characterizing multipath effects in multiple range environments, specifically regarding missile test missions. Additionally, the SET project continued efforts to develop the required hardware components (antenna, transmitter) required to conduct a missile test mission. Testing of this hardware began to characterize the telemetry link performance of the C-Band spectrum versus the legacy S-Band spectrum. SET continued efforts to develop airborne phased array antenna technology to enable flexible scheduling of the T&E spectrum by incorporating both the traditional L/S bands and recently permitted C-Band frequencies. Some of these technologies will reduce the technical risk associated with beam steering in the C-Band frequencies, reduce the amount of infrastructure modifications needed to implement a C-Band telemetry capability, and provide over-the-horizon data connectivity to test large-footprint weapons, such as long range missiles.

The SET project completed the development of a three dimensional channel model tool for modeling and simulation of telemetry channels in various environments. This tool provides higher fidelity simulations for use in researching the effects of terrain, environmental, and various other factors on telemetry channels. This tool was transitioned to the Edwards Air Force Flight Test Center to support pretest analysis of mission flight profiles. The SET project completed the development of a scheme to improve the efficiency of a networked telemetry system. This software scheme was transitioned to the CTEIP iNET program for incorporation into the iNET network link manager to address end-to-end system quality of service requirements. The SET project completed the development of an advanced RF spectrum management system to more efficiently manage spectrum resources at test ranges. This management system was tested at and transitioned to Naval Air Warfare Center – Aircraft Division, Patuxent River to aid in test planning and the assignment of RF spectrum resources.

The SET project initiated an effort to develop a non-blocking Ethernet switch capable of operation on an airborne platform. This technology will serve as the network backbone which will tie all onboard instrumentation together with the onboard transmitter. SET initiated an effort to autonomously analyze collected telemetry data and based on priority, select which data to transmit over the telemetry network. Additionally, SET initiated several efforts to improve the performance of telemetry data links. SET initiated an effort to improve the performance of a serial streaming telemetry link in a multipath environment by developing a sync marker for the telemetry data. This technology will enable analysis of the data in the event of a data dropout and permit filling in of holes in transmitted data. SET initiated an effort to develop a telemetry transceiver capable of dynamically reconfiguring the data modulation scheme based on telemetry link conditions.

FY 2014 Plans:

The SET project will further advance development of technologies required for network telemetry. Efforts to develop a multiband L/S/C-Band transceiver will continue. Technologies to develop advanced waveforms designed to increase bandwidth efficiency will be matured. Development of a networked data recorder in support of iNET will be completed, demonstrated, and transitioned to support the deployment of a networked telemetry system. Technology to improve efficiency of a telemetry network utilizing

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 2 / *Spectrum Efficient Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
the SOQPSK modulation scheme will be matured. Development of a non-blocking Ethernet switch for airborne platforms will be completed, demonstrated, and transitioned to support the deployment of a networked telemetry system. Phased array antenna technology utilizing both the traditional and C-Band frequencies will continue to be matured to enable flexible spectrum scheduling and alleviate technical risk associated with tracking and beam steering in the C-Band. The SET project will initiate efforts to develop an airborne multiband transceiver to support networked telemetry, increase spectrum scheduling efficiency, improve efficiency in ground telemetry and antenna systems, and support data transmission in both traditional L/S and C-bands. The effort investigating the telemetry link performance of the C-Band versus S-Band spectrum for a missile test mission will be completed and the results transitioned to the test ranges. The resulting telemetry antenna technology will be transitioned to Naval Air Warfare Center – Weapons Division, China Lake, but is designed to be extensible, enabling its widespread use across the Major Range and Test Facility Base. SET will initiate efforts to develop phased array technology for use on the ground as well as in airborne applications. The high directionality of phased array antenna technologies on aircraft will enable the ability to leverage spectrum spatial reuse techniques for more effective spectrum scheduling. Additionally, SET will initiate efforts to develop schemes to manage and provide access to telemetry links that are comprised of both contiguous and non-contiguous blocks of spectrum in the upper C-band. This portion of spectrum allocated for T&E is highly non-contiguous due to sharing with satellite and television uplinks in the spectrum band. ***FY 2015 Plans:*** The SET project will initiate development of radio technology that can utilize alternate spectrum in the upper frequency bands. These efforts will determine the feasibility of some of the upper bands for use in telemetry. Additional efforts on alternate data link technologies in the optical realm will be investigated. If efforts in this area are successful, these technologies can provide augmentation to the RF telemetry bands. Additionally, the SET project will complete work to mature technologies in optimization and management of the telemetry networks through spectrum management tools.			
Accomplishments/Planned Programs Subtotals	8.315	7.055	7.441

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Percentage of T&E/S&T projects progressing satisfactorily toward technical, financial, schedule, and risk mitigation goals.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense			Date: March 2014
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	Project (Number/Name) 3 / *Electronic Warfare Test*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
3: *Electronic Warfare Test*	19.127	18.827	15.569	8.172	-	8.172	9.971	12.573	15.105	16.564	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

Readily available, infrared (IR) seeking, man-portable air defense systems (MANPADS) are difficult to detect and pose an imminent and lethal threat to military aircraft of all types. Our ability to counter such threats is essential to owning the airspace in theater. Therefore, the ability to test missile warning systems (MWS), hostile fire indicators, IR countermeasures (IRCM), and advanced threat sensors is critical to our national defense. Additionally, a new generation of enemy radio frequency (RF) missile seekers is both currently fielded and in further development, requiring a correspondingly new generation of test technologies to test the latest countermeasures. The test and evaluation (T&E) community is required to test IRCM and RF countermeasure systems in a repeatable manner with ground-truth data before and after integration into warfighting systems. Without new test technologies, the Department of Defense (DoD) will be unable to perform adequate T&E of advanced warning and countermeasure systems.

The technology development efforts within the EWT project have been prioritized to align with DoD guidance on science and technology priority investments. As such, the EWT project is focusing on the test needs in both the electro-optic (EO), including IR, and the RF threat domains. Additionally, development of core test technologies in this area can be leveraged to meet other EO and RF test requirements, such as in fire control systems, reconnaissance sensors, and missile seeker subsystems.

The EWT project develops test technologies to stimulate IRCM and RF system sensors through the high-fidelity simulation of scenes viewed by the sensors. Stimulation can be as simple as testing to see if a system under test responds to an image or as complex as simulating complex battle space phenomena to measure the response of a system under test in a more relevant, cluttered scenario. Simulations and stimulations are used at open air ranges and in installed system test facilities (ISTF), and in hardware-in-the-loop (HWIL) test beds.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Electronic Warfare Test	18.827	15.569	8.172
FY 2013 Accomplishments: The EWT risk reduction effort for the Central Test and Evaluation Investment Program (CTEIP) Joint Distributed IRCM Ground-Test System (JDIGS) completed development and testing of a new superlattice light-emitting diode source. This technology provides two-color, high-temperature scenes with a frame rate fast enough to test new IRCM and MWS and is critical to improving DoD test capabilities for directional IR countermeasure (DIRCM) systems. EWT continued to develop a high temperature scene projector using resistive elements, including a method for tiling smaller arrays into a large array up to 2K x 2K pixels. The EWT Project completed development of a fiber optics technology for transmitting a scene to a gimbaled projector. EWT also completed testing of a laser radar scene projection technology. These provide the technology to transfer high power laser countermeasure emissions to instrumentation and target boards.			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 3 / *Electronic Warfare Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
The EWT project continued development of a hyperspectral imaging projector, which will allow characterization and testing of hyperspectral imaging cameras used for intelligence, surveillance and reconnaissance. The EWT project continued an effort to develop a breadboard technology to produce high-fidelity electronic counter-countermeasures (ECCM) radar signal processing techniques that employ sophisticated waveforms with algorithms, such as adaptive filtering. This test technology development addresses a need, which is identified by the Navy-led, CTEIP-sponsored Tri-Service Electronic Warfare Test Capabilities Study. The technology will improve testing against modern surface-to-air missile threats. Moreover, EWT continued efforts to develop a surrogate missile technology for testing of missile warning sensors. The EWT Project initiated a new effort for tracking of multiple projectiles for testing of hostile fire indicator sensors and systems. EWT also initiated a new effort to develop an adaptable Digital RF Memory (DRFM) system capable of producing 100 virtual targets. ***FY 2014 Plans:*** Risk reduction activities for CTEIP in testing MWS in integrated ISTF and HWIL facilities will continue. The EWT project will concentrate on addressing new test technology needs identified in the update to the IRCM Test Resource Requirements Roadmap. Furthermore, EWT technology developments will focus on stimulating synthetic aperture radars with RF injection, including realistic background clutter. Research will be conducted for testing wide area emitters. Efforts to develop surrogate missiles for testing of MWS and IRCM systems will continue. Efforts using DRFMs will continue. To address the testing of systems operating in the mid-wave IR band, the EWT project will develop technologies to enable comprehensive testing of mid-wave IR sensor and seekers by adding clutter models and scene generators to real-time stimulation technologies. Furthermore, efforts to develop technology to test against ECCM techniques of modern surface-to-air missiles will continue. ***FY 2015 Plans:*** The EWT project will invest in new technologies related to improving the electronic warfare T&E infrastructure. These new technologies will be identified by the Tri-Service EWT Working Group formed in FY 2011, and further address test needs identified in the IRCM Test Resource Requirements Roadmap, the Tri-Service Electronic Warfare Test Capabilities Study, and the Sensors and Seekers Test Requirements Study.			
Accomplishments/Planned Programs Subtotals	18.827	15.569	8.172

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 3 / *Electronic Warfare Test*

D. Acquisition Strategy

N/A

E. Performance Metrics

Percentage of T&E/S&T projects progressing satisfactorily toward technical, financial, schedule, and risk mitigation goals.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense			Date: March 2014
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	Project (Number/Name) 4 / *Advanced Instrumentation Systems Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
4: *Advanced Instrumentation Systems Technology*	10.025	8.570	10.036	11.610	-	11.610	10.066	9.779	11.530	13.704	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

The Advanced Instrumentation Systems Technology (AIST) project addresses the test technology gaps resulting from emerging weapon systems that need to be tested at Department of Defense (DoD) open air ranges, undersea ranges, installed systems test facilities, hardware-in-the-loop laboratories, and measurement test facilities. Instrumentation requirements for systems under test are increasing exponentially for new weapons systems. Vehicle on-board and warfighter wearable instrumentation packages are required. This instrumentation is for sensing and collecting critical performance data; determining accurate time, space, position information (TSPI)and attitude information; interfacing with command and control data links; monitoring and reporting system-wide communications; recording human operator performance; and storing and transmitting data.

The technology development efforts within the AIST project have been prioritized to align with DoD guidance on science and technology (S&T) priority investments, particularly in support of human systems, engineered resilient systems, and counter weapons of mass destruction. The AIST project is focused on supporting technology developments for advanced TSPI instrumentation (especially with limited or no use of the Global Positioning System (GPS)), advanced sensors, advanced energy and power systems for instrumentation, non-intrusive instrumentation, mitigating range encroachment issues, and measuring warfighter cognitive performance. The AIST project addresses requirements for miniaturized, non-intrusive instrumentation suites with increased survivability in harsh environments. Such instrumentation is an urgent need because minimal space is available to add instrumentation to new or existing weapon systems subsequent to their development; furthermore, additional weight and power draw for instrumentation can adversely affect weapon system signature and performance. Instrumentation for humans-in-the-loop, such as dismounted soldiers, must not adversely affect soldier performance, induce artificiality in the test environment, nor create operational burden. New technologies can be exploited to integrate small, non-intrusive instrumentation into emerging platforms during design and development, and, in some cases, into existing platforms. This class of instrumentation will provide critical system performance data during test and continuous assessment throughout a system's lifecycle. Technology developed under AIST can also benefit training and combat missions by enabling a continual feedback loop between the developer, training staff, operators and commanders.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Advanced Instrumentation Systems Technology	8.570	10.036	11.610
FY 2013 Accomplishments: The warfighter must conduct military operations in a diverse array of locations, to include urban, mountainous, and densely forested environments. Consequently, a continued major thrust for FY 2013 included the development of test technologies to support collection of TSPI for warfighter systems (manned or unmanned), particularly in GPS-denied or degraded environments, such as in urban canyons and tunnels. Efforts to test systems that operate in a GPS-denied environment included technology that employs a layered system of sensors leveraging collaborative navigation, existing radio frequency (RF) ranging technology, and a Doppler velocimeter to achieve more precise TSPI under GPS-impaired conditions. Preliminary testing in a realistic environment			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 4 / *Advanced Instrumentation Systems Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
was successfully conducted in both open-air and RF-challenged environments achieving sub-meter tracking accuracies. An inertial tracking system for dismounted warfighters continued in development; the system employs boot-mounted sensors to provide sub-meter geolocation over GPS-denied durations of greater than 2 hours. System integration and performance testing were conducted; design improvements are ongoing. To support testing of high-speed, high-acceleration systems, an ultra-high dynamics GPS receiver was developed. The receiver performs significantly better than existing test instrumentation. The AIST project gathered requirements for future test and evaluation GPS dependent TSPI activities, conducted analyses and mapped a way forward with respect to the development of application-specific integrated circuit (ASIC) design architectures for next generation solutions. In support of other instrumentation solutions, an electro-releasable attachment technology development effort continued. This included investigation of new adhesive formulations that employ an electrically releasing foil patch to allow attachment of sensors to non-conductive, painted exterior surfaces of aircraft and other combat vehicles. The goal is to provide immediate attachment for a test and significantly reduce the time to restore the system under test to its operational configuration. To support Electromagnetic Rail Gun (EMRG) developments, AIST continued development of a fiber-optic instrumentation suite to integrate into test projectiles to measure magnetic field strength in the harsh environment of an EMRG test firing. Powered air gun testing was successfully conducted at 50,000G levels at the Army Research Lab's Adelphi site. Preparations are underway to support full-up testing of an EMRG shot at the Naval Surface Warfare Center-Dahlgren Division. The AIST project developed algorithms and methods for automated detection and classification of marine mammal vocalizations from ocean floor range sensors (e.g., hydrophones) to improve testing at DoD undersea range complexes. Testing has been successfully conducted at undersea ranges and a baseline classifier for 6 marine mammal species is currently running real-time, range-wide at the Atlantic Undersea Test and Evaluation Center, Pacific Range Missile Facility, and the Southern California Offshore Range. This test technology allows the Navy to conduct critical test and evaluation (T&E) events without adversely impacting marine mammal populations, and to support the Navy's Integrated Comprehensive Monitoring Program (ICMP) ensuring adherence to the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA). Several efforts were initiated to develop technologies to: (1) measure position and attitude (six degrees of freedom) of high-velocity, spinning projectiles at accuracies that significantly exceed the system under test guidance system; (2) measure soldier/ soldier system indoor location (GPS-denied environment) at sub-meter accuracies using ambient AM radio broadcast signals; (3) provide seamless transition between outdoor and indoor environments to accurately track systems under test using modified GPS receivers, relayed GPS signals, and multi-lateration and multipath mitigation techniques; (4) use passive imaging to characterize munitions/warhead fragment size, velocity, and distribution, and significantly reduce set-up times and data analysis costs of current warhead arena test techniques; (5) accurately provide dynamic measurements and display the warfighter body posture, head and weapon orientation using fiber optic shape sensing of fibers integrated into uniforms and equipment; and (6) assess warfighter cognitive states using algorithms and measurements of brain electrical activity and brain blood oxygen levels. An effort was initiated to investigate mitigation of the impacts of wind energy system interference on test range radars.			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 4 / *Advanced Instrumentation Systems Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Efforts continued to assess and leverage microsystems technology under development at universities, the Defense Advanced Research Projects Agency (DARPA), and government laboratories. These efforts will provide significant advances to T&E of modern war fighting systems.			
FY 2014 Plans: Numerous warfighting systems are brought to theater by rapid acquisitions. These systems involve operations in extreme conditions, over long distances, for long durations, and often with very small physical footprints (i.e. microsystems). Furnishing adequate energy and power to instrument such systems for testing is a significant technological challenge. Major thrusts for FY 2014 include continuing ongoing efforts in advanced sensors, TSPI instrumentation, warfighter cognition assessment under various workloads, and test range encroachment mitigation. Additionally, AIST will continue to pursue test technologies for non-intrusive, advanced data acquisition and transformation that operate on reduced power along with the development of advanced power sources for test instrumentation. The AIST project will complete its assessment of emerging microsystems technology and develop a roadmap for potentially leveraging microsystems technologies in instrumentation at DoD ranges. The AIST project will complete: the development and testing of classifiers to identify specific sea mammals (e.g., various dolphins and whales species) found at undersea ranges; the development and testing of magnetic field sensors for the harsh environment of electromagnetic rail gun test firings; an attachment technology that does not require any solvents to restore test articles to operational condition; and several efforts for collecting TSPI on dismounted warfighters and related systems in GPS-denied or degraded environments such as those found in urban and subterranean operations.			
FY 2015 Plans: The AIST project will initiate efforts to develop advanced TSPI technologies for non-intrusive applications using wireless systems and optical, infrared, and/or acoustic techniques. TSPI technologies will be further developed to support: data collection in GPS-denied environments, TSPI on high dynamic systems such as missiles and projectiles, and TSPI on non-cooperative undersea weapon systems. Advanced sensor initiatives for non-intrusive applications will include multimodal transducers, and self-registering/self-calibrating sensors. Sensing applications will include weapon system orientation, body armor blunt trauma evaluation, air launched stores separation, angle of incidence measurement, and non-destructive radiographic defect evaluation for warheads and other weapons structures. Advanced data transformation initiatives will develop technologies for adaptive computing, virtual/synthetic instrumentation, data compression, wireless on-board data transport and improved data storage density. Other areas of investigation will include advanced data management techniques; decreased size, weight, and power; and micro-miniaturization of electronic components for non-intrusive applications. AIST will continue to investigate technologies for reducing or eliminating range environmental			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 4 / *Advanced Instrumentation Systems Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
encroachment issues. Additional efforts will include human performance measurement and assessment; specifically human interaction with unmanned systems.			
Accomplishments/Planned Programs Subtotals	8.570	10.036	11.610

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Percentage of T&E/S&T projects progressing satisfactorily toward technical, financial, schedule, and risk mitigation goals.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense			Date: March 2014
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	Project (Number/Name) 5 / *Directed Energy Test*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
5: *Directed Energy Test*	11.235	11.284	7.252	5.786	-	5.786	4.844	6.430	7.713	8.002	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

The Department of Defense (DoD) is exploring the military utility, safety, and suitability of directed energy weapons. A robust test capability to assess directed energy weapons is essential to understanding their effectiveness and limitations, including determining their effectiveness in performing counter improvised explosive device (C-IED) operations. Such assessments will depend upon knowledge acquired through the test and evaluation (T&E) of directed energy technologies and testing of operational concepts. Directed energy weapon technologies, primarily consisting of high energy lasers (HEL) and high powered microwaves (HPM), are outpacing available test capabilities. Traditional test techniques for evaluating conventional munitions (with flight times ranging from seconds to minutes) are not sufficient for the T&E of directed energy weapons that place energy on target instantaneously. Consequently, new test technology solutions are needed to ensure that adequate developmental, live-fire, and operational test capabilities are available when directed energy programs are ready to test.

Directed energy system and component testing requires three principal assessments: (1) energy or power on target; (2) the effects on the target; and (3) the propagation of the directed energy to the target through the atmosphere. In addition, the vulnerabilities of DoD systems to directed energy threats are required to be characterized in accordance with Military Standard (MIL-STD)-464C. Equally as important, current test capabilities do not provide the detailed data required to understand U.S. directed energy system performance and effects.

The technology development efforts within the Directed Energy Test (DET) project have been prioritized to align with DoD guidance on science and technology priority investments. As such, the DET project is developing the technologies necessary for quantitative assessment of United States HEL and HPM performance, as well as the vulnerability of DoD weapon systems to enemy directed energy threats.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Directed Energy Test	11.284	7.252	5.786

FY 2013 Accomplishments:

The DET project completed development of target board sensors to assess HEL energy on large targets. A new effort for measuring HEL energy on target for a small mortar was initiated.

Fabrication continued on a prototype adaptive optics system designed to be readily adaptable to telescopes at various test facilities. The test technology will allow improved imaging of an HEL spot on a remote target. Regarding HEL atmospheric propagation, a multi-light detection and ranging system to measure important atmospheric profiles along a slant path adjacent to the HEL beam propagation path continued. This technology simultaneously measured profiles for three parameters: optical turbulence, water vapor content, and aerosol attenuation. Measuring these profiles will enable understanding of how atmospheric effects distort HEL beam propagation. A maritime version of this technology was initiated.

Testing of electric field sensors continued in support of electromagnetic rail gun T&E and identified a prime source for indicating rail wear, a key issue for rail gun systems. To better support HPM C-IED testing, DET completed a test technology development

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 5 / *Directed Energy Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
to measure soil electrical properties using a brass board sensor with three interchangeable heads to cover the required frequencies. A demonstration of HEL sensor technologies on an unmanned aerial vehicle was completed; the demonstration verified the ability of the sensors to measure HEL energy on target while the HEL illuminated the aircraft to disable its intelligence, surveillance and reconnaissance systems. ***FY 2014 Plans:*** Within the HEL area, efforts will focus on continuing technology developments for measuring energy on target and characterizing effects on small targets using onboard sensing. Efforts will continue to address identified test technology shortfalls, including HEL test safety and HEL collateral effects. This includes efforts to improve the understanding of HEL reflection hazards so that testing of HEL systems can be accomplished safely without risk to observers and sensors. Furthermore, efforts to characterize beam propagation through the atmosphere will continue in the maritime environment to support emerging needs of the Navy. Initiatives to achieve very small, non-intrusive current and voltage sensors to measure HPM effects inside a target will be completed. These technologies will be transitioned to at least two locations to demonstrate the flexibility of these approaches. A small, minimally intrusive data acquisition device with a wide bandwidth to match that of the non-intrusive electric and magnetic field sensors will be continued. A HPM test risk reduction effort will be continued to determine the best approach to construct a more durable pressurized, radio frequency transmitting dome that does not leak over time for a test capability that emulates wideband HPM threats. An effort to develop an HPM source for use in a chamber to address survivability of munitions in an HPM environment will be continued. A new study investigating technologically-viable, more cost effective alternatives to provide the neutron radiation required for nuclear survivability testing will be continued. ***FY 2015 Plans:*** Investments in HEL test technologies will be initiated to assess the changes in HEL effects due to the shift of HELs to shorter wavelengths near 1 micron. In the HPM area, measuring the actual cause of HPM effects on electronics will be addressed by measurement of electrical currents within the wires and chips of the electronic targets.			
Accomplishments/Planned Programs Subtotals	11.284	7.252	5.786

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 5 / *Directed Energy Test*

D. Acquisition Strategy

N/A

E. Performance Metrics

Percentage of T&E/S&T projects progressing satisfactorily toward technical, financial, schedule, and risk mitigation goals.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense			Date: March 2014
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	Project (Number/Name) 6 / *Netcentric Systems Test*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
6: *Netcentric Systems Test*	20.072	16.590	14.518	16.658	-	16.658	12.931	9.834	10.756	10.344	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

The Net-Centric Systems Test (NST) project is pursuing test technologies to emulate multi-Service, Joint, and coalition net-centric operations in a system of systems test and evaluation (T&E) environment. Additionally, the NST project develops technologies to analyze and evaluate the increasingly massive amounts of structured and unstructured data generated by complex net-centric tests. The technology to conduct T&E on net-centric systems is challenged by sensor platforms, command and control systems and weapon platforms that support the kill chain in a Joint operation. These systems must be evaluated for their ability to provide an accurate, timely transfer of data (e.g., target tracks, weapons allocation, mission tasking and situational awareness), as the data passes among different systems of Service and coalition participants. The NST technologies advance test automation (test planning, test execution, test control, and analysis) that enable the virtual integration of Department of Defense (DoD) weapon laboratories and open air ranges. Using models and simulations along with hardware-in-the-loop laboratories, the effectiveness of Joint missions can be assessed in terms of system-of-systems interoperability and effectiveness in executing Joint mission operations, including testing of weapons and Command and Control systems accessing and providing information to the Global Information Grid. The technology development efforts within the NST project have been prioritized to align with DoD guidance on science and technology priority investments, particularly in measuring “Data to Decision” techniques and warfighting capabilities. Ultimately, the NST portfolio enables the T&E community to “test like we fight” by replicating net-enabled, Joint mission operations within a T&E environment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Netcentric Systems Test	16.590	14.518	16.658
FY 2013 Accomplishments: The NST project began technology development to analyze and process large amounts of heterogeneous data in real-time to facilitate decision making by test analysts. Technology development to automate the processes that analyze and evaluate multiple SoS in a joint cross-Service mission context were also initiated. Other efforts included technology development for planning a complex, multi-system, mission-level net-centric test in a distributed live-virtual-constructive (LVC) environment and controlling test execution through management of the mission scenario. The NST project developed test planning technologies to address test integration and interoperability issues. Machine reasoning capabilities were extended and integrated to automate test planning tasks. The NST project continued development of a planning and visualization technology to support joint mission thread testing to better correlate test data to the effectiveness of mission operations. The NST project advanced technologies to support the execution of distributed tests with active network control, enhanced the dynamic management of the test infrastructure, and improved the integration of Service laboratories and test ranges. These technologies were transitioned and integrated into the Central Test and Evaluation Investment Program (CTEIP) Test and Training			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 6 / *Netcentric Systems Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Enabling Architecture (TENA) that was used by the Joint Mission Environment Test Capability (JMETC) Program and at test facilities and training ranges. The NST project developed predictive smart dead-reckoning technology to address the challenge to adequately synchronize the distributed test environment. This effort provided the necessary distributed intelligence to manage time space position information (TSPI) updates in the net-centric test battlespace with a distributed LVC architecture. The NST project built upon previously developed NST technologies to solve the test challenges of producing accurate TSPI predictions under all network conditions, to include both unpredictable network latency and missing information. Since the predictive smart dead-reckoning technology is built on top of the policy-enabled agent, it will be able to provide fast response under complex test event conditions. The CTEIP Joint Distributed Infrared Countermeasures Ground-Testing System (JDIGS) project tested and validated this NST project to further improve the error performance for JDIGS testing over the JMETC network. The NST project also developed technologies for the next generation of TENA middleware that supported a broad range of networks, including wireless networks, and provided native support for handheld and embedded computing platforms. Global Positioning System and accelerometer test data were successfully transmitted over commercial cellular carriers using an encrypted virtual private network. The NST project transitioned technology to the Edwards Air Force Base Instrumentation Group by successfully demonstrating TENA connectivity through wireless networks providing a live or file replay of flight line instrumentation data on wireless tablet devices with real-time synchronization.			
FY 2014 Plans: The NST project will focus on efforts that enable TENA to utilize remote methods of authentication and privilege management to distributed users. This technology will support the DoD's remote authentication T&E needs and next generation multi-level security T&E capabilities. Additionally, the NST project will continue the development of technologies to support the measurement and analysis of the net-centric test environment including technologies that support enterprise level test execution assessment and control. The NST project will also develop technologies that apply automated analysis of large net-centric systems data sets using cloud computing technologies to reduce the time from data to decision. This project will investigate technologies that automate decision making by intelligently combining past actions on historical data in order to intuitively present a distributed test analyst with highly relevant actions based on real-time net-centric events.			
FY 2015 Plans: The NST project will continue developing technology that will automate the planning of test events based on advanced semantic web technology. Development will continue on technologies to support the use of TENA over a broad range of networks and to provide a common interoperability test architecture. Modeling and simulation technologies to support emulation and stimulation of			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 6 / *Netcentric Systems Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
networks for conducting T&E along with simulation fidelity assessments in the T&E context will also be investigated. Technology development that enables the rapid analysis of large unstructured data sets will also continue.			
Accomplishments/Planned Programs Subtotals	16.590	14.518	16.658

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Percentage of T&E/S&T projects progressing satisfactorily toward technical, financial, schedule, and risk mitigation goals.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense			Date: March 2014
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	Project (Number/Name) 7 / *Unmanned and Autonomous System Test*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
7: *Unmanned and Autonomous System Test*	3.159	5.273	5.918	5.024	-	5.024	4.621	9.155	10.636	11.252	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

Unmanned and Autonomous Systems (UAS) support every domain of warfare. They operate in space, in air, on land, on the sea surface, undersea and in subterranean conditions to support a vast variety of missions. The emergence of unmanned systems brings a host of revolutionary capabilities that will profoundly influence warfare. The Unmanned and Autonomous Systems Test (UAST) project addresses current and emerging challenges associated with the test and evaluation (T&E) of these critical warfighting capabilities. The technology development efforts within the UAST project have been prioritized to align with Department of Defense (DoD) guidance on science and technology priority investments, particularly in assessing autonomy. As such, the UAST project is developing test technologies to simulate, stimulate, instrument, measure, and assess autonomous systems' ability to perceive its environment, process information, adapt to dynamic conditions, make decisions, and effectively act on those decisions in the context of mission execution.

The UAST project will provide the test technologies to effectively measure performance and characterize risk, thereby increasing warfighter trust in autonomous systems. Current DoD test capabilities and methodologies are insufficient to address the testing of increasingly autonomous units and teams of unmanned systems operating in unstructured, dynamic, battlespace environments. Furthermore, advancements are being made in developing collaborating system-of-autonomous-systems, working in concert as a swarm or pack and in close proximity with humans. New test technologies are needed to stress the collective set of autonomous systems under realistic conditions, predict emergent behavior of autonomous systems, emulate the complex environment, and assess mission performance of these highly coupled and intelligent systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Unmanned and Autonomous System Test	5.273	5.918	5.024
FY 2013 Accomplishments: The UAST project focused on predicting and assessing the autonomy functions of unmanned and autonomous systems through the initiation of new technology developments. The complexity of operational unmanned and autonomous systems, with all possible interactions occurring between sensing, perception, reasoning, mapping, decision making and action, resulted in an almost infinite set of potential interactions and correspondingly, an almost infinite set of test conditions. An effort was initiated to employ evolutionary/genetic algorithms in a software-in-the-loop environment to accurately predict the fault conditions of a complex, long-duration autonomous system. Initially supporting testing of the Large Displacement – Unmanned Underwater Vehicle, this test technology was extended to improve the ability to predict fault conditions and focus test strategies for other types of unmanned vehicles. The UAST project effort initiated work to enhance safety of autonomous system testing to prevent unsafe UAS operations/actions. Additionally, work began to develop methods to measure autonomous system reliability and performance			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 7 / *Unmanned and Autonomous System Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
by providing complex and interactive live, virtual, constructive (LVC) test environments to stimulate UASs so their response and performance can be observed, recorded, and compared to pre-test simulations. In the area of autonomous system performance assessment, test technology development continued to enable automated autonomy architecture stress testing, with a focus on UAS software and the interfaces of the core components without requiring source code. The approach was agnostic to the specific component interface. This technology provided the tester with a perspective of system performance and a previously unavailable prediction of behavior. Recent stress-testing of a representative ground-based UAS system identified vulnerability issues at the command interface layer of the system. Additionally, in the area of autonomous system performance assessment, a virtual UAS proving ground was designed that used environmental data from external sources (to include imagery from operational areas of interest) and injected that data into simulations of a given UAS to predict the behavior of the system in the operational environment. An initial demonstration of this test technology facilitated efficient testing in operationally representative environments at Savannah River Test Site and Aberdeen Test Center and allowed for safe operations at “edge of the envelope” performance parameters.			
FY 2014 Plans: Efforts will focus on test technology supporting the near term challenges identified in the 2011 – 2036 DoD Unmanned Systems Integrated Roadmap, such as, integrating DoD unmanned systems within the National Airspace and safely operating unmanned aerial systems within our national ranges. The UAST project will further explore test technologies to meet the challenges of testing autonomy by leveraging advances made in the standardization of UAS architectures, functional components, and interfaces. The test technology to adapt evolutionary algorithms to predict fault conditions will be expanded to address evaluation functions for multiple missions of a long duration UAS. The UAST project will deliver a roadmap of potential test technology needs for testing autonomous systems at DoD ranges. The effort investigating the stress testing of autonomy architectures will be completed and the results transitioned to the test ranges. The resulting autonomy architecture stressing technology will be transitioned initially to Army Test and Evaluation Command, Aberdeen Test Center, but is designed to be extensible, enabling widespread use across the Major Range and Test Facility Base. Additionally, a virtual prototyping technology will be transitioned to test ranges to characterize UAS performance, reducing cost and time associated with open air range testing.			
FY 2015 Plans: The UAST project will deliver the technologies developed in the on-going efforts discussed above. Furthermore, the UAST project will continue to develop test technology that addresses mid-term UAS test challenges associated with autonomy and initiate efforts to explore the far term challenges of testing system intelligence. These efforts will include an examination of test technologies that measure the logical flow of sensing data, to perception, decisions, and action. Additionally, the UAST project will focus on enhancing the test environment to assess unmanned threat systems. The UAST project will develop instrumentation and analysis technologies to enable UAS testing that furnishes data to support the evaluation of overall mission performance in a Joint context. The UAST project will initiate efforts to enable dynamic construction, control, measurement of complex systems-of-			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 7 / *Unmanned and Autonomous System Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
autonomous-systems and tactically meaningful counter-unmanned systems analysis. Test requirements will expand to integrate multi-UAS test beds that support a simulation-based methodology to seamlessly integrate constructive simulation, UAS-in-the loop simulation, and live UAS tests. The UAST project will deliver complementary tools to predict UAS behavior by monitoring how autonomous systems process data in response to environmental changes. Simulated systems will replicate multiple platforms for the evaluation of multi-platform behaviors and detailed system/event logging. Modeling and simulation techniques will be expanded to provide high fidelity representations of appropriate environmental complexity in order to stress the UAS and establish confidence in the safety and capabilities of future systems.			
Accomplishments/Planned Programs Subtotals	5.273	5.918	5.024

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Percentage of T&E/S&T projects progressing satisfactorily toward technical, financial, schedule, and risk mitigation goals.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense			Date: March 2014
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	Project (Number/Name) 8 / *Cyberspace Test*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
8: *Cyberspace Test*	0.246	2.638	3.954	4.767	-	4.767	6.392	9.941	11.507	12.947	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

The Department of Defense (DoD) ability to use cyberspace for rapid communication and information sharing in support of operations is a critical enabler of DoD military missions. Advancements in utilizing cyberspace are outpacing the technologies needed for test and evaluation (T&E). The Cyberspace Test Technology (CTT) project will develop advanced technologies and methodologies to test and evaluate DoD capabilities and information networks to defend and conduct full-spectrum military operations across cyberspace. Current cyberspace T&E capabilities are insufficient to support the continual experimental, contractor, developmental, operational, and live-fire testing requirements of warfighter systems operating in cyberspace. Many of the test tools and infrastructure items required for systems in cyberspace will need advancement and maturation of various nascent test technologies. The CTT project has been aligned with DoD guidance on science and technology (S&T) priorities, specifically in the area of Cyber S&T. The CTT project will address test technology shortfalls in cyberspace testing, including planning cyberspace tests, creating representative cyberspace threats, and executing cyberspace tests.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Cyberspace Test	2.638	3.954	4.767
FY 2013 Accomplishments: The CTT project performed threat intelligence gathering, analysis, and design to develop prototypes for threat traffic generation and automated attack vectors. The project also began development of the initial framework for automated and verified sanitization processes on commodity information technology assets such as random access memory. The technology will eliminate traces of contaminating cyber attacks between tests, an important step in the cyberspace test execution process. Development on the CTT roadmap began mapping technologies to needs that synchronize with overall Department cyberspace plans.			
FY 2014 Plans: The work that began in FY 2013 will continue. The CTT project will focus on test technologies to address automated CTT planning and configuration. The CTT project will investigate the use of integrated cross-domain solutions and gateways to create realistic cyberspace tests at multiple levels of security classifications. Areas of research and development will include developing a reliable, fast, and cost-effective sanitization approach allowing the rapid repurposing of equipment between different tests to meet the expanding requirements for cyber testing. The CTT project will focus on threat cyberspace attack technologies required to assess information assurance vulnerabilities and to improve the agility of cyberspace test capabilities.			
FY 2015 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Office of Secretary Of Defense		Date: March 2014
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603941D8Z / *Test and Evaluation/ Science and Technology*	**Project (Number/Name)** 8 / *Cyberspace Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
The CTT project will continue to focus on technologies addressing the need to provide automated cyberspace T&E planning and configuration, improved threat representation and test execution and analysis, particularly in support of defensive cyberspace operations testing.			
Accomplishments/Planned Programs Subtotals	2.638	3.954	4.767

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Percentage of T&E/S&T projects progressing satisfactorily toward technical, financial, schedule, and risk mitigation goals.