Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Office of Secretary Of Defense										DATE: February 2011	
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*				R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*							
COST ($ in Millions)	**FY 2010**	**FY 2011**	**FY 2012 Base**	**FY 2012 OCO**	**FY 2012 Total**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**	**Cost To Complete**	**Total Cost**
Total Program Element	93.303	97.642	99.593	-	99.593	102.218	103.732	105.368	108.368	Continuing	Continuing
1: *Advanced Propulsion Test Technology*	19.372	24.159	20.783	-	20.783	19.363	28.038	14.759	15.377	Continuing	Continuing
2: *Spectrum Efficient Technology*	7.805	7.860	9.505	-	9.505	10.046	12.450	16.927	17.552	Continuing	Continuing
3: *Multi-Spectral Test*	19.617	19.688	18.263	-	18.263	15.206	12.396	10.775	13.201	Continuing	Continuing
4: *Advanced Instrumentation Systems Technology*	5.707	7.928	9.377	-	9.377	9.304	11.708	16.017	16.654	Continuing	Continuing
5: *Directed Energy Test*	20.826	19.965	10.899	-	10.899	10.985	10.200	15.186	13.906	Continuing	Continuing
6: *Netcentric Systems Test*	10.893	14.384	19.092	-	19.092	21.508	13.697	12.638	15.056	Continuing	Continuing
7: *Unmanned and Autonomous System Test*	2.583	3.658	6.724	-	6.724	10.250	9.561	11.973	9.695	Continuing	Continuing
8: *Common Range Integrated Instrumentation System*	6.500	-	-	-	-	-	-	-	-	Continuing	Continuing
9: *Multi-Level Security for T&E*	-	-	4.950	-	4.950	5.556	5.682	7.093	6.927	Continuing	Continuing

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 pace evolving weapons technologies. This program is critical to ensuring 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 6.2 applied research from the highly developed technology base in DoD laboratories and test centers, other government agencies, industry, and academia to accelerate the development of new test capabilities. This program element also provides travel funds for T&E/S&T program oversight, special studies, analyses, and strategic planning related to test capabilities and infrastructure.

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 2012 Office of Secretary Of Defense	DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603941D8Z: *Test and Evaluation/Science and Technology*

B. Program Change Summary ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Previous President's Budget	94.960	97.642	99.729	-	99.729
Current President's Budget	93.303	97.642	99.593	-	99.593
Total Adjustments	-1.657	-	-0.136	-	-0.136
• Congressional General Reductions		-			
• Congressional Directed Reductions		-			
• Congressional Rescissions	-	-			
• Congressional Adds		-			
• Congressional Directed Transfers		-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.513	-			
• Program Adjustments	-0.144	-	-	-	-
• Economic Asssumption Reductions	-	-	-0.136	-	-0.136

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 1: *Advanced Propulsion Test Technology*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
1: *Advanced Propulsion Test Technology*	19.372	24.159	20.783	-	20.783	19.363	28.038	14.759	15.377	Continuing	Continuing

A. Mission Description and Budget Item Justification

High speed and hypersonic weapons are being developed to ensure the continued military air superiority and strike capability of the United States. 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, air breathing space access vehicles, and high speed torpedoes. These systems require development of high speed turbine, ramjet, scramjet, and combined cycle engines; high temperature materials; thermal protection systems; and thermal management systems.

The Advanced Propulsion Test Technology (APTT) area develops technologies to enable robust, accurate, and timely Test and Evaluation (T&E) of these future weapon systems. DoD acquisition regulations require weapon systems to undergo a thorough T&E process in order to provide early detection of deficiencies and ensure system suitability and survivability. However, these weapons' extreme operational environments preclude accurate determination of their performance with today's T&E assets. Current national test capabilities have deficiencies in data accuracy, flight condition duplication and simulation, test methods, materials productivity, modeling and simulation (M&S) fidelity, and range safety. The APTT area is developing advanced T&E technologies in the areas of ground test, flight test, M&S, and instrumentation to fulfill T&E requirements. The APTT mission is to provide T&E technologies that will enable high speed and hypersonic weapon systems to be developed with the same accuracy and robustness as current lower speed systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Advanced Propulsion Test Technology	19.372	24.159	20.783
FY 2010 Accomplishments: FY 2010 was a year of considerable accomplishments including unprecedented advances in ground test technologies for air breathing propulsion and boost/glide weapons, development of new flight test capabilities, demonstration of new non-intrusive instrumentation for ground and flight test, and deployment of new modeling and simulation tools. Tests of a scramjet engine in a specially designed ground test facility allowed, for the first time, determination of the effects of using vitiated air on the performance of a hydrocarbon fueled scramjet engine. Current ground test facilities can only create the high temperature inlet conditions necessary for scramjet engine tests by burning fuel in the inlet flow. The resulting "vitiated air" (air contaminated with the products of combustion) has different gas properties than clean air which significantly affects the engine's performance and introduces errors into test data. Results from these important tests with both clean and vitiated air will improve the analysis of results from existing vitiated T&E facilities, help explain flight test results, improve M&S and guide investments in future T&E capabilities. Testing was also conducted to quantify the differences between impulse and blowdown aeropropulsion facilities, and to evaluate subscale verses full scale missile inlet test methods. These tests provide important new information to guide future weapon system T&E plans.			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 1: *Advanced Propulsion Test Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
In addition to vitiation effects, current hypersonic aeropropulsion facilities introduce high uncertainties in engine performance test results due to the limitation of operating at fixed Mach numbers instead of accelerating through variable Mach numbers in an operationally realistic manner (operability). Programmatic risks associated with fielding a hypersonic airbreathing missile can be greatly reduced by developing clean air heat addition and variable Mach number technologies. Several efforts to develop components for a next-generation hypersonic aeropropulsion test capability were completed this year while others continued to progress. Advances include: development of refractory materials and designs for a Mach 8, clean air storage heater; tests of two variable Mach number nozzle concepts; advanced materials and cooling schemes for nozzle throats; advanced high pressure/temperature facility components; and a modular fuel cracking system. Based on the success of these efforts, a new effort was initiated in FY10 to integrate these technologies into a small scale, clean air, variable Mach number, aeropropulsion test capability. Integrating these technologies into an operational facility will complete their development to Technology Readiness Level (TRL) 6, provide an on-going test asset to the DoD, and provide risk reduction for construction of a full scale facility. Key to the development of a clean air heater was development and initial testing of yttria-stabilized-zirconia bricks as the primary building block of future clean air heaters. Test results indicated the bricks can be heated to temperatures nearly 2,000 degrees hotter than molten steel and withstand the stresses of repeated dramatic rapid temperature changes without the degradation observed in earlier clean air heaters. Understanding ablation characteristics of thermal protection systems is critical for maneuvering reentry and boost/glide vehicles. Progress was made this year on increasing arc jet facilities' maximum enthalpy (available energy to simulate flight conditions) and run time, allowing for more realistic tests of leading edge materials. Additionally, a new test technique was pioneered utilizing low temperature ablators in existing wind tunnels which do not achieve true reentry temperatures to determine the affect of ablation on vehicles' stability and control and to provide data for validating ablation computer models. Advances in flight test technologies included progress towards an autonomous flight termination system and development of advanced flight maneuvers. The autonomous flight termination effort, designed to assure destruction of an errant hypersonic vehicle leaving its designated safety corridor, completed its design phase and is proceeding to fabrication of a brass board system. New instrumentation efforts initiated in FY10 included: the successful demonstrations in ground and flight tests of a new laser based non-intrusive flow measurement system that will use the mid-Infrared spectrum to greatly reduce uncertainties; a miniaturized, cooled wind tunnel balance specifically addressing a T&E gap in supersonic store separation capabilities; and development of a new miniature and robust fiber optic heat flux gauge was also completed and readied for ground test in early FY 2011.			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 1: *Advanced Propulsion Test Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Investment in a state-of-the-art validated computational fluid dynamics (CFD) tool resulted in the ability to simulate the very complex flows within scramjet engines. Physical modeling for turbulence, fuel-air combustion, and heat transfer were added and validated with test data. ***FY 2011 Plans:*** FY 2011 will see continued efforts to improve hypersonic ground test to levels required for acquisition programs, demonstration of new flight test techniques, improvements in instrumentation, and continued validation/improvement of CFD codes. Ground tests in direct connect and freejet test modes will be conducted to continue to quantify vitiation and test method effects on scramjet engine performance and operability. These tests will also provide a basis for identifying optimal test methods for larger, next generation scramjet engines. In addition, a methodology for truncating large 3-D inlets to fit within existing facilities and still provide accurate full scale inlet results will be tested. The Phase I work on the facility to integrate advance ground test component technologies will continue towards an initial testing capability with a goal of Mach 8 with fixed Mach number nozzles. The primary thrust in FY 2011 will be construction of the yttria-stabilized-zirconia storage heater and attendant modifications to a demonstration test facility. Design work for subsequent phases will be geared towards providing variable flight conditions. Improved electrodes will be demonstrated in an arc jet facility enabling greatly improved T&E of maneuvering reentry and boost/glide vehicles. These systems will also benefit from continued development of test techniques involving low temperature ablators. A system to enable propulsion testing beyond Mach 8 using magnetohydrodynamics to accelerate flow ionized by electron beams will also be demonstrated. A first generation, autonomous flight termination system will be built and undergo hardware-in-the-loop testing. Results from these tests will be incorporated into a flight rated, second generation design. Development of an improved laser based non-intrusive flow measurement system will continue as will construction of a miniaturized, cooled wind tunnel balance for supersonic store separation. Both instruments will be demonstrated in relevant environments. Validation and improvement of the CFD code will continue, making use of the unique datasets obtained from the scramjet engines tests mentioned above. ***FY 2012 Plans:*** Continuing efforts in FY 2012 will be centered on completion of the integration facility to demonstrate clean air aeropropulsion testing up to Mach 8. Technology development will continue with construction of hardware which will enable variable pressure, temperature and enthalpy with fixed nozzles. Testing for vitiation, test methodology and scale effects will conclude and will cumulatively provide the most extensive examination of hypersonic aeropropulsion methods yet accomplished and will enable significant improvements in the quality of data provided to weapon system developers. Work on a new mid-IR non-intrusive flow measurement and a miniaturized, cooled wind tunnel balance will conclude in FY 2012. New test technology efforts will be			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 1: *Advanced Propulsion Test Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
initiated addressing: test technologies, techniques, and methodologies to determine full-scale propulsion system performance and operability from subscale tests; technology for continuous flow, clean air heat addition up to Mach 6 to enable full-scale, combined cycle, propulsion system test; further development of M&S codes for accurate prediction of flow fields, boundary layer transition, and heat transfer in high speed flow; test technologies and methodologies to support long run time, clean air, true temperature testing; and test technology in support of advanced rail guns.			
Accomplishments/Planned Programs Subtotals	19.372	24.159	20.783

C. Other Program Funding Summary ($ in Millions)

N/A

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 2012 Office of Secretary Of Defense			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 2: *Spectrum Efficient Technology*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
2: *Spectrum Efficient Technology*	7.805	7.860	9.505	-	9.505	10.046	12.450	16.927	17.552	Continuing	Continuing

A. Mission Description and Budget Item Justification

Weapon systems have experienced a significant increase in complexity over the past fifty years, in which an extraordinary amount of data is passed among these systems, and between the systems and our test infrastructure. Accordingly, a vast amount of data must be collected, transmitted, and analyzed, which in turn requires a large amount of spectrum resources. However, the amount of radio frequency (RF) spectrum designated to support test and evaluation (T&E) is decreasing, most notably due to re-allocations for commercial use. This combination of decreasing RF spectrum with increasing data requirements results in an urgent need to create test technologies that maximize the use of spectrum resources for DoD T&E operations.

The L and S frequency bands constitute the traditional spectrum allotted for military use. The explosive need for spectrum in the commercial sector has resulted in portions of these bands being reallocated to industry. To compensate for this, DoD has been authorized to use the C-Band spectrum. C-Band offers numerous benefits to DoD, including a three-fold increase in available bandwidth, but it comes with a number of technical challenges. Most notably, our test infrastructure for telemetry is not designed to accommodate C-Band. Technologies are required to implement innovative techniques that efficiently extend our use of C-Band without a major overhaul to our national test infrastructure. As a case in point, commercial telemetry transmitters operating in C-Band exist; however, they do not have the form factor (size and weight) or the packaging (i.e. not ruggedized) to survive airborne test applications.

Traditional telemetry applications employ streaming telemetry in which data is moved one-way from the instrumented System Under Test to our test infrastructure. Modern network based telemetry capabilities, such as those being developed by the Central Test and Evaluation Investment Program (CTEIP), enable much more robust and efficient bidirectional transfer of data. DoD's strategy is to create technologies for streaming telemetry capability in C-Band, thereby opening up the legacy L and S-Bands for networked telemetry usage.

The Spectrum Efficient Technology (SET) area is pursuing T&E technologies that enable more efficient use of legacy telemetry bands and expansion into non-traditional areas of the RF and optical spectra. These technology advancements will address both the growing data requirements of warfighting systems and the limited availability of spectrum to support T&E. The SET area is structured to develop technologies required for a networked telemetry system, improve efficiency of streaming telemetry hardware, and pursue technologies required to utilize the C-Band spectrum. Several technology advancements supporting the development of networked telemetry systems serve as risk reduction efforts for CTEIP.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Spectrum Efficient Technology	7.805	7.860	9.505
FY 2010 Accomplishments: To keep pace with increasing data requirements, SET pursued efforts and technologies to increase the efficiency of streaming telemetry systems, enable networked telemetry, and expand telemetry operations into the recently acquired C-Band spectrum. In order to achieve more efficient streaming telemetry hardware, it is necessary to develop methods to mitigate and reduce errors in the data link, advanced waveforms, and data coding techniques. SET developed methods to mitigate the effects of multipath and forward error correction techniques to reduce errors in the streaming telemetry link. The forward error correction			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 2: *Spectrum Efficient Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
schemes transitioned to the Range Commanders Council Telemetry Group for inclusion into the Inter-Range Instrumentation Group telemetry standards. The research and development of a Continuous Phase Modulation-Orthogonal Frequency Division Multiplexing (CPM-OFDM) waveform, capable of supporting simultaneous high data rate test assets within a limited amount of RF spectrum, was initiated to improve spectrum utilization and efficiency. The SET area emphasized developing the technologies to enable the development a networked telemetry system. SET further matured technologies to optimize and manage the telemetry network by continuing the development of policy-based network management tools and initiating efforts to develop spectrum and network management systems. These efforts seek to increase network throughput, spectrum utilization, and overall telemetry network performance. Technologies to enable the dynamic reconfiguration of the test data parameters transmitted over the telemetry network were further matured and provided risk reduction in support of CTEIP development. The ability to reconfigure the data link improves efficiency by allowing the transmission of desired test data only. SET also continued development of technologies to support networked telemetry requirements in other environments, such as those for ground based unmanned autonomous systems testing. In order to support the expansion of telemetry operations into non-traditional areas of the RF spectrum, SET pursued efforts to analyze the T&E spectrum in the C-Band. This resulted in representative RF channel models, which are necessary to facilitate the development of telemetry hardware. SET initiated the development of a wideband power amplifier to increase the efficiency of the amplifier over a wide range of frequencies, specifically the traditional T&E spectrum and the C-Band. The RF C-Band channel models were transitioned to open air ranges to support C-Band telemetry development. ***FY 2011 Plans:*** SET will continue the emphasis on developing technologies to meet networked telemetry requirements and perform risk reduction for CTEIP. Technology enabling the dynamic reconfiguration of transmitted test data over the network will be transitioned to an initial operational capability. Policy-based management tools to optimize data throughput and increase spectrum utilization will be matured. Spectrum and network management technology will continue, with a focus on capabilities that allow for dynamic distribution of spectrum resources amongst test participants. The spectrum and network management technologies matured by SET will support CTEIP developments. Advanced waveform technologies will be developed to increase data throughput. A networked telemetry transceiver using the OFDM waveform will be developed and tested as a risk reduction effort for iNET, the CTEIP project developing advanced network telemetry capability. Efforts to develop networked data recorders will also be initiated. SET will develop technologies required to expand telemetry operations into non-traditional spectrum bands. The development of a wideband power amplifier that is capable of efficiently operating within the traditional and C-Band spectra will be matured further to increase spectrum utilization and support the development of a robust C-Band telemetry capability. Additionally, SET will initiate efforts to research and develop phased array antenna technology (both ground and airborne) that will enable flexible			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 2: *Spectrum Efficient Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
scheduling of the T&E spectrum by incorporating both the traditional and C-Band frequencies. These technologies will reduce the technical risk associated with beam steering in the C-Band frequencies while reducing the amount of infrastructure modifications needed to implement a C-Band telemetry capability. ***FY 2012 Plans:*** SET will further advance the development of technologies required for network telemetry. Efforts to develop policy-based network management tools will be completed, demonstrated, and transitioned to support CTEIP developments. Spectrum and network management systems, including a suite of network protocols, will be demonstrated and transitioned to CTEIP as well. Technologies to develop advanced waveforms designed to increase data throughput will be matured. The development of advanced waveforms will enable the telemetry network to support multiple high data rate test assets and will increase efficiency and spectrum utilization. Support of CTEIP risk reduction to develop networked data recorders will continue and the technology will be matured. Emphasis will be placed on the development and maturation of technologies required to expand telemetry operations in other frequency ranges, as well. The effort to develop a wideband linear power amplifier will be completed. This technology will be demonstrated and transitioned to open air ranges. 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. Efforts to develop an airborne multiband transceiver will be initiated to support networked telemetry, increase spectrum scheduling, and support two-way data transmission of the telemetry network.			
Accomplishments/Planned Programs Subtotals	7.805	7.860	9.505

C. Other Program Funding Summary ($ in Millions)

N/A

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 2012 Office of Secretary Of Defense			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 3: *Multi-Spectral Test*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
3: *Multi-Spectral Test*	19.617	19.688	18.263	-	18.263	15.206	12.396	10.775	13.201	Continuing	Continuing

A. Mission Description and Budget Item Justification

Easy to use and readily available, man-portable air defense systems (MANPADS) pose an imminent and acute threat to military aircraft and civilian airliners. Our ability to counter such threats is essential to achieve the military objective of owning the airspace in theater and safely operating commercial air traffic within the National Airspace. Therefore, the ability to test Missile Warning Systems, Hostile Fire Indicators, Infrared Countermeasures and advanced sensors is critical to our national defense. Additionally, a new generation of missile seekers is in development and requires a new generation of test technologies for effective assessment. The Multi-Spectral Test (MST) technology area develops technology in three major domains related to testing seekers and sensors: prediction, measurement, and stimulation. Prediction entails the accurate emulation of a sensor or a seeker in a simulation. Measurement deals with all interactions between an object of interest (e.g., a threat) and its immediate environment (e.g., sun glint, moisture in the air, and exhaust). Stimulation involves “painting” a test pattern, an image, or a changing scene on a system under test (SUT). Stimulation can be as simple as testing to see if an SUT responds to a stimulus (e.g., an image) or as complex as simulating battle scene events to measure the response of an SUT in a more relevant scenario. Stimulations and simulations are used at open air ranges (OAR), in installed system test facilities (ISTF), and in hardware-in-the-loop (HWIL) test beds.

The test and evaluation (T&E) community is required to test advanced seekers and sensors in a repeatable, objective fashion with validated ground-truth data before and after seeker/sensor integration into warfighting systems. Without new technologies, DoD will be unable to perform adequate T&E of multi-spectral and hyperspectral weapon systems of the future. MST is working to address all electro-magnetic bandwidth requirements of concern to the major test ranges and facilities. This includes advancing technologies to test polarization, radio frequency through ultra-violet bands, radar, laser radar (LADAR), and seismic systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Multi-Spectral Test	19.617	19.688	18.263
FY 2010 Accomplishments: MST initiated several projects in FY 2010 to develop technology to test seekers and sensors, to perform risk reduction/mitigation for the Central Test and Evaluation Investment Program (CTEIP), and to support the Infrared Countermeasures (IRCM) Test Resource Requirements Study. These MST projects include development of a high-temperature scene emitter, which enables enhanced environmental measurement and generation of battle scenes. MST developed sub-array light emitting diode technology, including an ultra-violet open air range array that tests missile warning systems (MWS) and transitioned this technology to support the test community. The sub-array light emitting diode technology developed under MST extends the range that MANPADS engagements can be tested. MST emitters and projector technology initiatives, which include designs for testing at an ISTF, HWIL, and OAR, are progressing very well. The Superlattice Light Emitting Diode initiative is approaching the final stages of testing prior to integration into a MWS test suite. Technologies are being pursued to address challenges in hostile fire indication, which include a Micro-Plasma Emitter project.			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 3: *Multi-Spectral Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
MST has made significant progress with the Read-In Integrated Circuit technology, which supplies electrical energy to emitters that feed images in ISTF and HWIL facilities. This technology is preparing for final testing before transition. The circuit will enable sensor testing at frame rate speeds and sufficient power to give our warfighters a technological edge on the battlefield for years to come. This technology will support multiple DoD test ranges and several emitter arrays under development in the MST portfolio. ***FY 2011 Plans:*** Two of the current efforts in MST's portfolio – Superlattice Light Emitting Diodes and Multispectral Polarized Scene Projector – are scheduled to complete in FY 2011. The former is developing a mid-wave/long-wave infrared high temperature, high frame rate emitter, and the latter is developing a short-wave infrared projector to test polarized sensors that detect man-made objects. Risk reduction activities for CTEIP in testing MWS in integrated ISTF and HWIL will continue. MST will invest in technologies designed to attain the goal of real-time scene generation. Investments will also be placed to address technology gaps identified in the IRCM Test Resource Requirements Study. Technologies will be pursued to stimulate synthetic aperture radars with radio frequency "imagery" and research will be conducted for wide area emitters. Moreover, MST will pursue the development of clutter models and the capability to project clutter onto a synthetic aperture radar. ***FY 2012 Plans:*** To address the testing of systems operating in the mid-wave infrared bandwidth, MST will develop technologies to enable the full testing of mid-wave infrared sensor/seekers by adding clutter models and scene generators to real-time stimulation. In addition, test technologies for testing MWS in integrated ISTF and HWIL will be transitioned to CTEIP.			
Accomplishments/Planned Programs Subtotals	19.617	19.688	18.263

C. Other Program Funding Summary ($ in Millions)

N/A

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 2012 Office of Secretary Of Defense			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 4: *Advanced Instrumentation Systems Technology*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
4: *Advanced Instrumentation Systems Technology*	5.707	7.928	9.377	-	9.377	9.304	11.708	16.017	16.654	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Advanced Instrumentation Systems Technology (AIST) Area addresses the test and evaluation needs and technology gaps involved in instrumenting next generation warfighting systems and the complex environments in which they operate. Instrumentation requirements for systems under test are increasing exponentially for new weapons systems. On-board and personnel-borne instrumentation are required for sensing and collecting critical performance data; determining accurate time, space, position, and attitude information; interfacing with command and control data links; monitoring and reporting system-wide communications; reporting human operator performance; and storing and transmitting data. The AIST area addresses requirements driven by the need to enable technologies for miniaturized, non-intrusive instrumentation suites with increased survivability in harsh environments. Minimal space is available to add instrumentation to new or existing weapon systems subsequent to their development; moreover, additional weight and power draw can adversely affect weapon system signature and performance. Instrumentation for humans-in-the-loop, such as dismounted soldiers, should neither adversely affect soldier performance nor create operational burden. New technologies can be exploited to integrate small, non-intrusive instrumentation into new platforms during design and development, and, in some cases, into existing platforms. This class of instrumentation can provide the data required for continuous assessment throughout a system's lifecycle and can enable the collection of critical system performance data during test, training, and combat missions, thereby enabling an ongoing feedback loop between the developer, test personnel, and operator.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Advanced Instrumentation Systems Technology	5.707	7.928	9.377
FY 2010 Accomplishments: The Warfighter has a need to conduct military operations in urban environments. Consequently, a major thrust for FY 2010 included the development of test technologies to support collection of time, space, position information (TSPI) data for soldier systems (manned or unmanned), particularly in GPS-denied or degraded environments such as urban areas and tunnels. Additionally, TSPI data is needed in other environments (e.g., underwater) and for high speed/acceleration systems under test where GPS can be denied or degraded. A high accuracy chip scale atomic clock (initially developed by the Defense Advanced Research Projects Agency) was matured and integrated with acoustic modems to be positioned on the seafloor for accurate TSPI measurement on submarine and torpedo systems under test. Software modifications were made to an airborne GPS sensor unit to reject multipath signals and software changes were validated through simulation, ground testing, and flight testing. This technology directly supported risk reduction for the Central Test and Evaluation Investment Program (CTEIP) Joint Advanced Missile Instrumentation system. Other major development areas in FY 2010 included the development of advanced sensor instrumentation technologies (non-intrusive, miniature, and hardened for harsh environments) and advanced data acquisition. Four probes were developed			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 4: *Advanced Instrumentation Systems Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
to measure gas species, temperature, pressure, and Mach/flow angularity in gas turbine engines. An additional probe was developed for simultaneous analysis of turbine engine exhaust products (i.e., carbon, nitrogen, water vapor, and hydrocarbons). An open, modular, scalable, embedded systems architecture was developed to support data acquisition for system-of-systems testing. In addition, based on the revised AIST roadmap, three new efforts were initiated in FY 2010, and technology investments are being applied to develop a fiber-optic instrumentation test suite to support an electromagnetic rail gun weapon system. Warfighting systems and forces are increasingly being asked to operate in environments that have previously been inaccessible (e.g. tunnels, caves, etc.) or outside of historical mission areas (e.g. urban environment), which poses significant challenges in tracking systems under test. An additional thrust for FY2010 involves the need to test systems that operate in a GPS-denied environment. One technology involves networking GPS enabled systems within the test environment, and using the network to integrate GPS and other positional information across the connected nodes by sharing raw observables from GPS and inter-node ranges to locate each network node with high reliability. A second technological approach employs a layered system of navigation sensors leveraging collaborative navigation, existing RF ranging technology, and a Doppler velocimeter to achieve more precise positional information.			
FY 2011 Plans: Numerous systems now being brought to theater by rapid acquisitions, involve operations in extreme conditions, over long distances, for long durations, and often with very small physical footprints (i.e. micro-systems). Furnishing adequate energy and power to instrument such systems for testing is a significant technological challenge. Major thrusts for FY 2011 include continuing the FY 2010 efforts in advanced sensors, TSPI instrumentation, and advanced data acquisition/transformation, along with the development of advanced power sources for test instrumentation. AIST will complete technology development of an agile wide-area radio frequency location scheme for soldier positioning, a wide-band positioning system to locate soldiers and unmanned ground vehicles in GPS-denied or impaired areas (e.g., inside buildings and complex structures in an urban environment), and new GPS receivers with high-dynamic, multi-frequency, anti-jamming capability to provide TSPI in GPS-denied environments. These technologies will support range safety, system analysis, mission optimization, and end game scoring of highly dynamic objects.			
FY 2012 Plans: In FY 2012, AIST will complete or continue efforts initiated in prior fiscal years. New efforts will be initiated focusing on developing advanced TSPI technologies for non-intrusive applications, using wireless systems and optical, infrared, and/or acoustic techniques. TSPI technologies will be developed to support data collection in GPS denied environments, position data collection for projectiles, data collection for high dynamic systems, TSPI technologies uniquely suited to swimmers and divers, and TSPI data collection for non-cooperative undersea weapon systems.			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 4: *Advanced Instrumentation Systems Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Advanced sensor development initiatives for non-intrusive applications will include multimodal transducers, self-registering sensors, and sensor attachment technologies. Sensing applications include body armor blunt trauma evaluation, warfighter body posture and orientation, weapon system orientation, angle of incidence/stores separation, and station keeping buoys. Advanced power/energy initiatives will develop technologies for non-intrusive application, particularly energy harvesting devices and load management devices. This includes electromechanical fuels cells and support for personnel-borne instrumentation. Advanced data transformation initiatives will develop technologies for adaptive computing, self-configuration, and self-calibration of instrumentation. Additional goals includevirtual/synthetic instrumentation measurements, self-configuration data reduction, data compression, and on-board data transport and storage.			
Accomplishments/Planned Programs Subtotals	5.707	7.928	9.377

C. Other Program Funding Summary ($ in Millions)

N/A

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 2012 Office of Secretary Of Defense			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 5: *Directed Energy Test*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
5: *Directed Energy Test*	20.826	19.965	10.899	-	10.899	10.985	10.200	15.186	13.906	Continuing	Continuing

A. Mission Description and Budget Item Justification

Directed energy weapon technologies are transitioning rapidly into acquisition programs and Joint Concept Technology Demonstrations. DoD is exploring the military utility and suitability of these weapons. A robust capability to assess directed energy weapons is essential to understand how and when to best employ directed energy in warfighting applications, including the operational capability to utilize directed energy systems to perform counter improvised explosive device (C-IED) operations. Such assessments will depend upon knowledge acquired through the test and evaluation (T&E) of these technologies and testing of operational concepts. Associated weapon technologies, primarily consisting of High Energy Lasers (HEL) and High Power Microwaves (HPM), are outpacing supporting test technologies. HEL and HPM advancements have created a new class of weapon systems in which energy is placed on a target instantaneously. Traditional test techniques for evaluating conventional munitions (with flight times ranging from seconds to minutes) are not sufficient for the T&E of these types of systems. Consequently, new 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. DoD 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 vulnerability of DoD systems to HPM and HEL threats needs to be characterized in accordance with MIL-STD-464B. Current test capabilities do not provide the detailed data required to understand directed energy system performance and effects. The T&E/S&T Directed Energy Test technology area is developing the technologies necessary for quantitative assessment of HEL and HPM performance, as well as the vulnerability of DoD weapons system to directed energy threats.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Directed Energy Test	20.826	19.965	10.899
FY 2010 Accomplishments: The investments in HEL energy on target test technologies yielded a number of successful technology transitions in FY2010 including a prototype ground-based HEL diagnostics sensor to measure HEL engagements, an adaptive optics system to improve image quality that compensates for atmospheric distortions, and a hyper spectral imager to characterize multiple laser wavelengths during a HEL engagement. Each of these technologies has been integrated onto a pointing system at an open air range used for tracking HEL engagements. Investments were initiated to migrate from off-board HEL measurement systems to on-board target board sensors that more directly measure the energy on target. In the area of HEL effects on target, an HEL measurement system enabling measurement of laser power during a high energy laser lethality test was transitioned. Efforts to measure temperature of an HEL target and technology investments in temperature modeling progressed, showing great promise for successful implementation. Additionally, technologies to support lethality measurements of solid state lasers were initiated. In the area of HEL atmospheric characterization, a system to measure optical turbulence and atmospheric transmission over long paths in strong turbulence progressed on schedule. An investment strategy was implemented in which HEL test technologies			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 5: *Directed Energy Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012

are shifting from supporting chemical laser weapons systems to the class of solid state laser systems that are currently in development.
In the area of HPM energy on target, a target board to measure the full spatial and temporal profile of W-band millimeter wave systems in real-time was developed. Technologies to support the testing of area denial microwave weapons remained an area of focus, with a combination of ongoing and newly initiated activities. These efforts include a number of sensor development projects addressing the need to measure the electric and magnetic fields associated with the HPM incident on a target. This capability, employing an optical data link, must operate non-intrusively and have the ability to capture data without being negatively impacted by the effects of the HPM on the measurement system.
FY 2010 activities included work on the urgent need to characterize HPM sources and performance of HPM systems to perform C-IED operations, including an effort to develop an electromagnetic properties measurement system of soil which will greatly improve the ability to test the effectiveness of C-IED systems. Finally, a number of efforts focused on developing technology to support testing of the vulnerability of DoD systems to HPM threats, including technologies to adjust beam power, polarization, wavelength, and bandwidth of an emulated threat.

FY 2011 Plans:
Within the HEL area, efforts will focus on measuring energy on target and characterizing effects on target using onboard sensing. In addition, test technologies will focus to the characterization of solid state laser effects on targets in support of weapons systems in development and demonstration by the Army, Navy, and Air Force. Technologies to support the measurement of laser lethality on rockets, artillery, mortars, and unmanned air vehicle targets will remain a key area of investment. Furthermore, efforts to characterize beam propagation through the atmosphere will center on the maritime environment in support of emerging needs of the Navy. Investment will be placed in laser safety software and hardware to allow testing at multiple test ranges without affecting aircraft and space sensors.
In the area of HPM, the efforts to provide non-intrusive electric field and magnetic field sensors will continue, along with new efforts to provide measurements of induced currents. These test technologies are needed to determine the effects of HPM on electronic systems to support a number of area denial HPM weapons in development. Modeling and simulation of HPM effects on systems will receive increased attention. In the area of C-IED, technologies to measure soil electromagnetic properties will be continued along with modeling and simulation efforts to support testing of HPM C-IED weapons. Enhanced sensor and simulation tools are expected for determining the effects of HPM threat systems on DoD systems in accordance with MIL-STD-464B.

FY 2012 Plans:
In FY 2012, the investments in HEL will target the technologies to support the testing of HEL energy on target, as well as the HEL effects of solid state lasers and fiber laser systems. As the development of electromagnetic rail guns and the free electron lasers advance, investments in test technologies supporting these weapon systems will be initiated. Tunable over a wide range,

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 5: *Directed Energy Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
free electron lasers present unique testing challenges for open air testing, including measuring laser energy on target as well as characterizing the beam propagation and thermal blooming effects. Test technologies will be pursued to support testing of HPM systems with longer ranges over broader areas, as well as the ability to measure collateral damage effects. Several systems currently in development are scheduled to be nearing operational testing in the FY 2012 timeframe and will require additional investments in simulation of HPM effects to adequately assess operational effectiveness. The development of test technologies supporting MIL-STD-464B will continue and expand to address emerging threats.			
Accomplishments/Planned Programs Subtotals	20.826	19.965	10.899

C. Other Program Funding Summary ($ in Millions)

N/A

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 2012 Office of Secretary Of Defense			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 6: *Netcentric Systems Test*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
6: *Netcentric Systems Test*	10.893	14.384	19.092	-	19.092	21.508	13.697	12.638	15.056	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Net-Centric Systems Test (NST) Technology Area is pursuing technologies to test our ability to fight in an information age by advancing technologies that assess the interoperability, accuracy, and mission effectiveness of information systems supporting Joint Net-Centric Operations (JNO). Information systems and weapon/ sensor platforms that support the kill chain in a Joint operation must provide an accurately transfer of timely data, such as target tracks, weapons allocation, mission tasking and situational assessment, as it is passed between different systems, Services and coalition participants. NST technologies advance the test tools (test planning, test execution, test control, and analysis) that enable the virtual integration of the Services' weapon laboratories and open air ranges. Using simulations and 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 (C2) systems accessing and providing information to the Global Information Grid (GIG). Furthermore, the NST technology area develops new test technologies that support the assessment of systems and networks to defend against cyber attack. The NST portfolio enables the test community to "test like we fight" by replicating net-enabled, Joint mission operations.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Netcentric Systems Test	10.893	14.384	19.092
FY 2010 Accomplishments: NST has placed an emphasis on test technologies supporting the abilities to manage a net-centric test battlespace, including planning a complex, multi-player, mission level net-centric test in a distributed Live-Virtual-Constructive simulated environment and controlling test execution through management of the mission scenario. In FY 2010, NST developed new test technologies that allow test personnel to examine the feasibility of proposed test architectures to achieve the desired test objectives and to automate the process of constructing the test environment. In addition, investments were applied in technologies that enables near real-time analysis of joint mission threads. These technologies have already been applied in test venues to baseline the Joint Close Air Support mission thread. Mission level net-centric tests are most often conducted over a distributed test network. Test personnel require the ability to manage this network and control the test systems connected via the network. NST advanced technologies to support the execution of distributed tests with active network control, enhanced the degree of dynamic management of the test infrastructure, and improved the integration of Service laboratories and test ranges by transitioning new technologies into the Test and Training Enabling Architecture (TENA). NST is investing in technologies to test military systems that employ Service-Oriented Architectures (SOA). In FY 2010, NST transitioned test technologies to the Central Test and Evaluation Investment Program (CTEIP) Interoperability Test and Evaluation Capability (InterTEC) project to collect SOA-related performance data on new GIG-enabled intelligence systems. In addition,			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 6: *Netcentric Systems Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
NST transitioned to the InterTEC project an agile tactical message protocol parser that can collect, display, and analyze different Service communication protocols used in the Joint mission kill chain. In FY 2010, NST continued ongoing efforts to develop test technologies automating Net-Ready Key Performance Parameter (KPP) evaluations and to replicate the net-centric battlespace to enable realistic testing of system and network capabilities to defend against and fight through a cyber attack. ***FY 2011 Plans:*** In FY 2011, NST will focus on test technologies that upgrade simulation and stimulation capabilities to provide a more accurate representation of the battlespace environment. The technology for an enterprise tool will be developed that will enable simulation of a wide range of network and host-based information operations effects that can be centrally managed and controlled. In addition, test technologies to allow the test personnel to emulate red cyber warfare capabilities will be developed, expanding the types of attacks simulated on systems under test. New test technology development will be continued to extend TENA to embedded instrumentation and smart devices, as well as optimize data structures to operate more efficiently over wireless networks. Additionally, NST will continue the development of technologies to support the measurement and analysis of the net-centric test environment. The analysis of joint mission threads in near real-time will be assisted by the development of a test technology that will allow effective characterization and replication of JNO mission threads. A test technology to provide automated Net-Ready Key Performance Parameter compliance analysis will be completed and transitioned to the CTEIP InterTEC project. ***FY 2012 Plans:*** In FY 2012, NST will focus on providing technology to enable the NST architecture to evaluate mission effectiveness. A test technology that will assist with this need by providing intelligent test analytic and visualization tools to support Joint mission effectiveness, net readiness, and joint interoperability evaluation will transition to the CTEIP InterTEC project. Additionally, work will continue on developing technologies to improve the ability to recreate the net-centric test battlespace, including development of test technologies required to validate and verify the net-centric test environment. The cyber attack simulation/stimulation system will be further expanded to represent coordinated network attacks (such as, bot attacks) on systems under test. The testing of SOA will be emphasized through the research and development of instrumentation and analysis tools utilizing embedded agent-based technologies. Additional test technology development will be conducted in semantic interoperability and defining ontologies that formalize concepts pertaining to distributed test resources in a Net-Centric Joint Mission Environment. Development will continue on technologies to support the use of TENA over a broad range of networks and to provide common interoperability architecture. Moreover, NST will initiate efforts to develop technologies that analyze the impact of cyber and Information Operations and to support the Information Assurance certification of the test environment.			
Accomplishments/Planned Programs Subtotals	10.893	14.384	19.092

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603941D8Z: *Test and Evaluation/Science and Technology*	**PROJECT** 6: *Netcentric Systems Test*

C. Other Program Funding Summary ($ in Millions)

N/A

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 2012 Office of Secretary Of Defense			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 7: *Unmanned and Autonomous System Test*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
7: *Unmanned and Autonomous System Test*	2.583	3.658	6.724	-	6.724	10.250	9.561	11.973	9.695	Continuing	Continuing

A. Mission Description and Budget Item Justification

Supporting every domain of warfare and poised to support the vast variety of missions, Unmanned and Autonomous Systems (UAS) are operating in space, in air, on land, on sea, undersea and in sub-terrain conditions. The emergence of robotics and other forms of UAS in the battlespace brings a host of revolutionary capabilities that will profoundly influence warfare. The Unmanned and Autonomous Systems Test (UAST) Technology Area addresses current and emerging challenges associated with the test and evaluation of these critical warfighting assets. UAST is developing test technologies to stimulate, instrument, measure, and assess the capability of an autonomous system to perceive its environment, process information, adapt to dynamic conditions, make decisions, and effectively act on those decisions. A principal tenant of UAST is to provide the test technologies that will effectively measure performance and characterize risk, thereby increasing the warfighter's 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 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 systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Unmanned and Autonomous System Test	2.583	3.658	6.724
FY 2010 Accomplishments: FY 2010 activities focused on test technologies to create a test framework for UAS testing to predict autonomous behavior and verify safe operations in a test environment. Test technologies to support instrumentation, protocols, predictive models, and test measures/methods are being developed to test UAS performance, collaboration, and interoperability. UAST completed technology development on a framework that enables systematic and structured testing of UAS systems using a combination of simulation, hardware-in-the-loop, and live testing. Within a week of this delivery, test personnel were able to execute test plans quickly and efficiently, and verify UAS performance with respect to command and control navigation approaches utilizing non-line-of-sight techniques, collision avoidance, team coordination, and fault tolerance under various failure modes and bandwidth constraints. Test technology solutions progressed for the development of models and simulations of environments at the proper fidelity to predict the behavior of intelligent systems and Systems-of-Systems. These test technologies will enable planning complex UAS tests to facilitate design of the test scenario, construction of the test environment, instrumentation and analysis planning, and system safety assessments. Furthermore, test technology progressed to provide an integrated, agent based framework that			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 7: *Unmanned and Autonomous System Test*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
supports “fail safe” methods to control and disarm a weaponized UAS. This test technology will greatly assist in ensuring safe operations of lethal UAS missions on the test ranges. ***FY 2011 Plans:*** In FY 2011, UAST will address test requirements unique to UAS by investing in tools to predict, emulate, and assess behaviors and anomalies to expedite acquisition of UAS for the warfighter. Efforts will be undertaken to create emulation technologies, which use rapid data collection methods to appropriately stimulate systems under test. Additional efforts will focus on ground truth maps with varying resolution for comparison with UAS live test data to support performance assessment across land, air, and maritime environments. Test technologies will be established to assess increased autonomy of single, multiple, and collaborative sea surface vehicles to provide insight into control, performance, and cooperative unmanned undersea vehicle (UUV) navigation. These investments include development of models of UUV operation in remote, inaccessible, and dynamic environments. This test technology will enable UUV test personnel to guide UUV development and deployment, help define testing for cooperating underwater vehicles, and advance fielding of autonomous undersea systems that are suitable, effective, and survivable. New efforts will be initiated to extend the physical limits of test and training ranges to emulate a rich, dense UAS battlespace environment with adequate fidelity using simulations, developing adaptive target controls and instrumentation to stimulate a system-of-autonomous-systems, and test technology for unobtrusive fail-safe mechanisms to terminate or assume control of an autonomous system under test. ***FY 2012 Plans:*** Efforts in FY 2012 will focus on technology for instrumentation and analysis of UAS testing to furnish data that supports the optimization of mission performance, as well as test technology to support the automation of test planning and test scenario synthesis. UAST will invest in efforts to enable dynamic construction, control, and measurement of complex system-of-autonomous-systems. 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. UAST 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 development of multi-platform behaviors, supporting repeatable events, 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. New efforts will be initiated to instrument and assess the autonomy logic processing, developing embedded test agents to unobtrusively extract and correlate flow from stimuli to output as related to predicted behavior, test technology to predict and assess emergent behavior of cooperative swarms of intelligent systems operating in dynamic environments, and instrumentation and analytics to measure machine-to-machine interactions of cooperative, intelligent UAS in a mission context.			
Accomplishments/Planned Programs Subtotals	2.583	3.658	6.724

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 7: *Unmanned and Autonomous System Test*

C. Other Program Funding Summary ($ in Millions)

N/A

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 2012 Office of Secretary Of Defense			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 8: *Common Range Integrated Instrumentation System*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
8: *Common Range Integrated Instrumentation System*	6.500	-	-	-	-	-	-	-	-	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Department of Defense has a critical need for enhanced test and evaluation (T&E) instrumentation to support advanced aircraft, avionics, and weapons system testing. The Common Range Integrated Instrumentation System (CRIIS) is a Tri-Service project that provides a family of capabilities to improve time-space-position information (TSPI) accuracy in low- to high-dynamic test environments and data link throughput capabilities using spectrally efficient data links. CRIIS participant packages will be highly miniaturized in both pod-mounted and internally-mounted configurations.

CRIIS is highly dependent upon advanced technology development in the areas of high-accuracy TSPI and spectrally efficient, high throughput data transmission.

CRIIS will replace the aging Advanced Range Data System (ARDS), which was developed in the mid-1980s, suffers from parts obsolescence, and is unable to provide the accuracy and data throughput required by advanced weapon systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Common Range Integrated Instrumentation System	6.500	-	-
FY 2010 Accomplishments: Completed Phase I Risk Reduction and Technology Maturation for high throughput, spectrally efficient data link. Completed Phase I Risk Reduction and Technology Maturation for high accuracy TSPI. Accomplished a field test demonstration and Technology Readiness Assessment. Transitioned these technologies to the Central Test and Evaluation Investment Program for CRIIS development activities.			
FY 2011 Plans: N/A			
FY 2012 Plans: N/A			
Accomplishments/Planned Programs Subtotals	6.500	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 8: *Common Range Integrated Instrumentation System*

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 2012 Office of Secretary Of Defense			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 9: *Multi-Level Security for T&E*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
9: *Multi-Level Security for T&E*	-	-	4.950	-	4.950	5.556	5.682	7.093	6.927	Continuing	Continuing

A. Mission Description and Budget Item Justification

Multi-level security (MLS) technologies for Test and Evaluation (T&E) will allow information to flow freely between testers who have the appropriate security credentials to access mission essential information while preventing leaks to unauthorized recipients. MLS test systems must incorporate three essential features: first, the system must enforce these restrictions regardless of the actions of system users or administrators, second, enforce these restrictions with incredibly high reliability, and third, allow assured acess for the bidirectional flow of information classified at multiple levels of security to accredited parties across the test infrastructure. These requirements have led developers to implement specialized security mechanisms and apply sophisticated techniques to review, analyze, and test those mechanisms for correct and reliable behavior. These specialized mechanisms constitute point solutions that are certified for use in a specific system configuration and for a particular network architecture, thereby resulting in the need for numerous solutions to address varied test environments. The consequence of this uniqueness is a low degree of efficiency coupled with a low degree of capability.

The MLS needs of testing have recently grown significantly to include: (1) new test concepts and related infrastructure enhancements, such as distributed testing over a national test network and passing test data over telemetry streams of multiple classification levels; (2) test operations in an information rich battlespace, such as testing of network centric operations; (3) the need to exchange information with systems and people that have differing levels of authorization for information access, such as testing with coalition partners; and (4) testing of systems that produce, transmit and consume information of varying levels of classification, such as information operations. Test technologies that enable the aforementioned test capabilities will significantly increase efficiency and generate cost savings.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Multi-Level Security for T&E	-	-	4.950
FY 2010 Accomplishments: No T&E/S&T investments were applied to MLS in FY 2010. The T&E/S&T Program is closely monitoring the MLS Joint Network Test Environment project being executed under the Central Test and Evaluation Investment Program (CTEIP), currently in the requirements definition phase. The requirements for MLS and Cross Domain Solutions, as applicable to testing, will be discerned by this CTEIP project.			
FY 2011 Plans: The T&E/S&T Program will collaborate with CTEIP to assess technology gaps associated with MLS capabilities/requirements as identified in the MLS Joint Network Environment project.			
FY 2012 Plans: Based upon the results of the requirements definition and technology assessment process undertaken in concert with CTEIP, T&E/S&T investments will be placed to mature the required technology and mitigate associated risk for the development of MLS			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Office of Secretary Of Defense		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603941D8Z: *Test and Evaluation/Science and Technology*	PROJECT 9: *Multi-Level Security for T&E*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
test capabilities. Abilities to enable reconfigurable/reprogrammable software cross domain solutions, bidirectional data guards, and MLS in open-air transmission are among the key enabling technologies requiring T&E/S&T investment.			
Accomplishments/Planned Programs Subtotals	-	-	4.950

C. Other Program Funding Summary ($ in Millions)

N/A

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.