Exhibit R-2, RDT&E Budget Item Justification							February 2006
OPERATIONAL TEST AND EVALUATION, DEFENSE (0460) BUDGET ACTIVITY THREE			TEST AND EVALUATION/SCIENCE AND TECHNOLOGY (T&E/S&T) PROGRAM ELEMENT (PE) 0603941D8Z				
$ in Millions	FY 2005	FY 2006*	FY 2007*	FY 2008*	FY 2009*	FY 2010*	FY 2011*
PE 0603941D	14.654						
Hypersonic Test	2.887						
Spectrum Efficient Technology	2.027						
Multi-Spectral Test	3.357						
Embedded Instrumentation	2.681						
Directed Energy Test	2.893						
Netcentric Systems Test	0.809						
Advanced Unmanned Vehicle System Development	0.000						
Software Test	0.000						
Modeling and Simulation	0.000						

Test Range/Facility Technology Improvements	0.000						

***Language in the National Defense Authorization Act of 2003 directed the establishment of the Test Resource Management Center (TRMC). The Act also requires the TRMC to administer the Central Test and Evaluation Investment Program (CTEIP) and the Test and Evaluation/Science and Technology (T&E/S&T) program effective Fiscal Year 2006.**

Beginning with FY 2006, program elements 0603941D8Z (T&E/S&T) and 0604940D8Z (CTEIP) transferred from the Operational Test and Evaluation, Defense (OTE, D) appropriation (0460) to the Defense-wide RDT&E (0400) appropriation. FY 2005 Accomplishments are in the OTE,D appropriation.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION

The T&E/S&T program seeks out and develops test technologies to pace evolving weapons technology. This program is critical to ensuring that the Department of Defense (DoD) has the capability to adequately test the advanced systems that will be fielded in the future. To meet this objective, the T&E/S&T program:

- Exploits new technologies and processes to meet important T&E requirements.
- Expedites the transition of new technologies from the laboratory environment to the T&E community.
- Leverages commercial equipment and networking innovations to support T&E.

Additionally, the program examines emerging test requirements derived from transformation initiatives to identify needed technology areas and develop a long-range roadmap for technology insertion. This program leverages and employs applicable 6.2 applied research from the highly-developed technology base in the DoD laboratories and test centers, industry, and academia to accelerate the development of new test capabilities. This PE also provides funds to perform travel to carry out oversight of the T&E/S&T program.

This Research Category 6.3, Advanced Technology Development PE, develops and demonstrates high payoff technologies for current and future DoD test capabilities.

B. (U) PROGRAM CHANGE SUMMARY

	FY 2005	FY 2006*	FY 2007*
FY 2006 President's Budget:	14.654		
FY 2007 President's Budget:	14.654		
Total Adjustments:			
Congressional Program Reductions:			
Congressional Rescissions:			
Congressional Increases:			
Program Adjustment			

C. (U) OTHER PROGRAM FUNDING SUMMARY NA

D. (U) ACQUISITION STRATEGY NA

E. (U) 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						February 2006	
OPERATIONAL TEST AND EVALUATION, DEFENSE (0460) BUDGET ACTIVITY THREE, PE 0603941D			HYPERSONIC TEST				
$ in Millions	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Hypersonic Test	2.887						

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION

The National Aerospace Initiative (NAI) will develop air-breathing weapons, advanced aircraft, and access to space platforms to operate in the hypersonic speed regimes Mach 5 and higher. Hypersonic systems to be developed under the NAI require T&E capabilities in numerous areas ranging from ground testing (wind tunnels, sled tracks, installed-system test facilities, and modeling and simulation (including computational fluid dynamics)) through flight testing. At hypersonic speeds, flight testing will challenge existing ground instrumentation systems (e.g., tracking system slew rate limitations, telemetry dropouts due to ionization) and range safety decision making. Hypersonic weapon systems will depend on several new technological thrusts in areas such as propulsion and engines, structures and materials, guidance and control, seekers and sensors, warheads and payloads, and weapons delivery techniques and end-game dynamics - each requiring supporting T&E capabilities to determine performance, effectiveness, suitability, survivability, and responsiveness to Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems. Service improvement and modernization programs are addressing some basic test facility upgrades using off-the-shelf technologies. However, T&E of hypersonic systems will require technologies not yet developed or available for T&E purposes. The Department must have adequate T&E capabilities in place in time to meet current development, and ultimately, acquisition program schedules. The purpose of this T&E/S&T focus area is to address these T&E technology issues.

B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM

	FY 2005	FY 2006	FY 2007
Hypersonic Test	2.887		

FY 2005 Accomplishments:

Investigations initiated in prior years continued. Highlights for these projects include:

- Completed Hypersonic Aeropropulsion System Flight Trajectory T&E risk reduction efforts to optimize the variable Mach testing technologies for the Central Test and Evaluation Investment Program (CTEIP) Propulsion Test Capability project in the Aerodynamic and Propulsion Test Unit (APTU) facility at Arnold Engineering Development Center (AEDC). This will allow system developers and testers to perform realistic "fly the mission" testing instead of the current single Mach number testing performed in existing ground test facilities.
- Completed Hypersonic Wind Tunnel Nozzle Survivability for T&E by successfully fabricating new high strength nozzle throats able to support wind tunnel testing up to Mach 12 flight conditions.
- Completed Heat Flux Sensor Development for Aerothermal Measurements by successfully fabricating and calibrating miniaturized heat flux sensors that can be embedded in hypersonic vehicles to support wind tunnel and flight testing. These heat flux sensors demonstrated an 8-fold increase in heat measurement capacity.
- Continued Test Media Effects efforts to develop a unique laser-based velocity measurement technique that allows simultaneous measurement of three components of velocity for characterization of wind tunnel environments.

Initiated new research efforts into Pulsed Electron Beam Spectroscopy, Microelectromechanical (MEMS) Shear Stress Sensors, High Heat Flux Sensors, and In-Flight Combustion Gas Analysis.

FY 2006 Plans: NA

FY 2007 Plans: NA

C. (U) OTHER PROGRAM FUNDING SUMMARY NA

D. (U) ACQUISITION STRATEGY NA

Exhibit R-2a, RDT&E Project Justification						February 2006	
OPERATIONAL TEST AND EVALUATION, DEFENSE (0460) BUDGET ACTIVITY THREE, PE 0603941D			SPECTRUM EFFICIENT TECHNOLOGY				
$ in Millions	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Spectrum Efficient Technology	2.027						

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION

Increased commercial use of the radio frequency (RF) spectrum and DoD's higher demands for bandwidth and test data are impacting the capability to test current weapon systems. Realistic testing of modern military systems, and follow-on training at the completion of a defense system's development phase, rely heavily on the use of the RF spectrum, especially in the "L" and "S" microwave bands. Signal propagation, supportable data rates, and other related characteristics make these bands ideally suited for test telemetry and training applications. However, these are the same characteristics that make these bands highly coveted by the wireless communications industry. The growth in the demand for consumer communication services has resulted in reallocation of RF spectrum from government to non-government use. The reallocation of this spectrum, coupled with the increase in activities that use it, has raised concerns regarding the availability of adequate spectrum to support test and training. Each new generation of military system typically generates ten times more data and information than the system it is replacing, resulting in a 20-year trend of exceptional growth in the demand for test and training related spectrum. The next generation of systems will generate proportionately greater data rates that will exceed the capability of our current test infrastructure. Technological advances in the spectrum efficiency focus area are required to ensure that programs will not have to compromise T&E by reducing the number or quality of tests.

B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM

	FY 2005	FY 2006	FY 2007

Spectrum Efficient Technology	2.027		

FY 2005 Accomplishments:

Investigations initiated in prior fiscal years continued. Highlights for these projects include:

- Completed SHF Channel Modeling and Implementation efforts to develop a channel model characterizing ground interference in the SHF bands. Initiated efforts to incorporate effects of sea interference in the SHF bands. The final channel model will allow development of advanced modulation techniques to mitigate interference in the SHF band.
- Completed Optical Communications efforts to identify technology developments required to use optical communications for telemetry. The results of this analysis were used to develop portions of the FY2006 BAA for Spectrum Efficient Technologies.
- Continued Spectrally Efficient High Data Rate Telemetry System for Super High Frequency (SHF) efforts to conduct flight demonstrations of a brassboard AOFDM transmitter and receiver with increased throughput to provide robust telemetry in the SHF band. This brassboard demonstrated improved link availability for aeronautical telemetry applications.
- Continued Radio Frequency (RF) Microelectromechanical Systems (MEMS) efforts to demonstrate a MEMS-based antenna system that will be capable of steering an RF beam and switching between different frequencies. This will improve the efficiency of telemetry signals and allow the use of a single antenna over different telemetry bands.

Initiated research into Beamformer Antennas..

FY 2006 Plans: NA

FY 2007 Plans: NA

C. (U) OTHER PROGRAM FUNDING SUMMARY NA

D. (U) ACQUISITION STRATEGY NA

Exhibit R-2a, RDT&E Project Justification						February 2006	
OPERATIONAL TEST AND EVALUATION, DEFENSE (0460) BUDGET ACTIVITY THREE, PE 0603941D			MULTI-SPECTRAL TEST				
$ in Millions	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Multi-Spectral Test	3.357						

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION

DoD S&T programs are developing new technologies for use in multi-spectral and hyperspectral sensors, seekers, and detectors for weapon systems and intelligence, surveillance, and reconnaissance systems. T&E of new multi-spectral and hyperspectral sensors to be used in these future weapon systems will require new T&E technologies. Current methods for testing multi-spectral and hyperspectral sensors rely heavily on expensive field test programs. While these field tests provide realistic data for sensor testing, they leave several critical gaps. For example, test conditions are not repeatable because environments observed one day will be different the next day. Imagery can be collected and stored to partially mitigate this deficiency, but this process is expensive and cannot cover the full spectrum of environments required for complete test article evaluation and performance analysis. The T&E community needs the ability to test these advanced seekers and sensors in a repeatable, objective fashion before and after integrating them into warfighting systems. This T&E/S&T focus area is addressing these needs through research efforts in scene generation, injection and projection to create test technologies that can be combined into integrated multi-spectral and hyperspectral test capabilities. Without these new T&E technologies, DoD will not be able to adequately test and evaluate the multi-spectral and hyperspectral weapon systems of the future.

B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM

	FY 2005	FY 2006	FY 2007

Multi-Spectral Test	3.357		

FY 2005 Accomplishments:

Investigations initiated in prior years continued. Highlights for these projects include:

- Completed Dynamic Hyperspectral Thermal Signature Model first version of the signature model for test. The initial release includes two-way interactions between targets and 3-dimensional terrain, vegetation, and cultural background objects to allow generation of high fidelity Long Wave Infrared (LWIR) scenes for multi-spectral and hyperspectral sensor evaluation.
- Continued Hyperspectral Testbed Design through successful completion of the Technical Design Review (TDR) for the prototype LWIR system. The TDR included a detailed design review of the primary subsystems: the Thermal Pixel Array (TPA), Digital Micro-mirror Device (DMD), and the reverse spectrometer.
- Continued Multi-Spectral Stimulator Injection Test Method effort to fabricate of the prototype system. A Test and Training Enabling Architecture (TENA) gateway and real-time radio frequency (RF) clutter hardware were successfully integrated into the system.

Initiated a new research effort into Ultraviolet Light Emitting Diodes (UV LEDs) for T&E of Missile Warning Systems (MWSs).

FY 2006 Plans: NA

FY 2007 Plans: NA

C. (U) OTHER PROGRAM FUNDING SUMMARY NA

D. (U) ACQUISITION STRATEGY NA

Exhibit R-2a, RDT&E Project Justification						February 2006	
OPERATIONAL TEST AND EVALUATION, DEFENSE (0460) BUDGET ACTIVITY THREE, PE 0603941D			EMBEDDED INSTRUMENTATION				
$ in Millions	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Embedded Instrumentation	2.681						

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION

Instrumentation requirements for systems-under-test, hardware-in-the-loop testing, and training are increasing exponentially for new weapon systems. Onboard or personnel-borne instrumentation and equipment 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. These requirements drive the need for enabling technologies for miniaturized, non-intrusive instrumentation suites with increased survivability in harsh environments.

There is minimal space available for adding instrumentation to new weapon systems subsequent to their development. Additional weight and power draw can adversely affect the weapon system's signature and performance. Instrumentation for humans-in-the-loop, such as a dismounted soldier, should not detrimentally affect the soldier's performance or operational burden. New technologies can be exploited to integrate small non-intrusive embedded instrumentation (EI) into new platforms during design and development, and, in some cases, into existing platforms. This EI can provide the required data for T&E, training, and logistics throughout the system's lifecycle, and provide the ability to collect critical system performance data during combat missions.

The use of embedded instrumentation for T&E, training, and logistics has the potential for significantly reducing the total ownership costs of new weapon systems while enhancing force readiness. Accordingly, the Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3170.01D states that acquisition programs should include embedded instrumentation as part of system trade-off studies and design analyses. The EI focus area will advance T&E technologies needed to facilitate compliance with CJCSI 3170.01D.

B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM

	FY 2005	FY 2006	FY 2007
Embedded Instrumentation	2.681		

FY 2005 Accomplishments:

Investigations initiated in prior fiscal years continued. Highlights for these projects include:

- Completed Carbon Monoxide (CO) MEMS for Gas Turbine Engines testing of a new design gas emissions sensor. This new sensor will allow measurement of CO concentration in the gas stream to support T&E of gas turbine engines.
- Completed D-fiber Optic Sensor fabrication and demonstration of multi-axis stress and temperature sensors etched onto D-fiber. These sensors will provide a low-cost technique for embedding sensors on systems during development.

Initiated new research efforts into High Speed and Temperature Diagnostics, Open Modular Embedded Architecture, Software Architecture for EI and Digital Communications Data Bus.

FY 2006 Plans: NA

FY 2007 Plans: NA

C. (U) OTHER PROGRAM FUNDING SUMMARY NA

D. (U) ACQUISITION STRATEGY NA

Exhibit R-2a, RDT&E Project Justification						February 2006	
OPERATIONAL TEST AND EVALUATION, DEFENSE (0460) BUDGET ACTIVITY THREE, PE 0603941D			DIRECTED ENERGY TEST				
$ in Millions	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Directed Energy Test	2.893						

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION

Directed Energy (DE) technologies are rapidly transitioning into acquisition programs and Advanced Concept Technology Demonstrations (ACTDs). These weapons technologies, which primarily consist of High Energy Laser (HEL) and High Power Microwaves (HPM), are outpacing their supporting test technologies. Advancements in HEL and HPM have created a new class of weapon systems in which energy is placed on a target instantaneously, making traditional test techniques for evaluating conventional munitions (with flight times ranging from seconds to minutes) not applicable to DE systems' T&E. As a result, new technology solutions are needed to ensure adequate developmental, live fire, and operational test capabilities are available when the DE acquisition programs are ready to test.

DE system and component testing requires two principal assessments: how well the weapon is performing and the specific interaction of energy and target. The current ability to assess DE systems performance and interactions is based on effects testing, i.e. determining if and when the target was destroyed. This does not provide the detailed test data required to understand DE system performance. Military utility of these weapons will be dependent on the knowledge acquired through T&E to know how much to trust the technologies under development and how best to use them. This T&E/S&T focus area is developing the needed technologies to quantitatively assess both HEL and HPM performance and target interaction to support thorough testing of DE systems.

B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM

	FY 2005	FY 2006	FY 2007

Directed Energy Test	2.893		

FY 2005 Accomplishments:

Investigations initiated in prior fiscal years continued. Highlights for these projects include:

- Completed Beam Redistribution System by successfully assembling and demonstrating five single mirrors and fabricating and testing a Chemical Oxygen-Iodine Laser (COIL) four mirror prototype system. The COIL four mirror system demonstrated the ability to create far-field beam characteristics in the near-field to support T&E of HEL systems within the limited confines of laser ranges. A simulation was also developed to facilitate design of future BRSs that can be tailored to specific HEL systems and far-field beam patterns. The prototype mirrors were transitioned through the CTEIP Directed Energy Test and Evaluation Capability (DETEC) project for use at Arnold Engineering and Development Center (AEDC) to support lethality testing in the Aerodynamic and Propulsion Test Unit (APTU). The simulation software and design documents also transitioned to the High Energy Laser System Test Facility (HELSTF) through the CTEIP DETEC project.
- Continued Range Profiles of Turbulence by successfully demonstrating the conceptual design of Differential Image Motion (DIM) Light Detection and Ranging (LIDAR) system using commercial components. This demonstration verified the ability to remotely characterize optical turbulence along a HEL beam path to support T&E of laser weapon systems.

Initiated new research efforts into Electro-optical Sensor Technology and Dielectric Electromagnetic Field Probes for T&E of HPM systems and an Off-Target Temperature Sensor and T&E Adaptive Optics System for T&E of HEL systems.

FY 2006 Plans: NA

FY 2007 Plans: NA

C. (U) OTHER PROGRAM FUNDING SUMMARY NA

D. (U) ACQUISITION STRATEGY NA

Exhibit R-2a, RDT&E Project Justification						February 2006	
OPERATIONAL TEST AND EVALUATION, DEFENSE (0460) BUDGET ACTIVITY THREE, PE 0603941D			NETCENTRIC SYSTEMS TEST				
$ in Millions	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Netcentric Systems Test	0.809						

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION

The S&T community is developing advanced Netcentric Systems to support DoD's Critical Transformational Capabilities—Conduct Information Operations, Deny Enemy Sanctuary, and Leverage Information Technologies. Advancements in Netcentric Systems will provide commanders and staff with an adaptive, network-centric, configurable operational information visualization environment, which will improve the speed and quality of command decisions. Information assurance and survivability are central to achieving these advancements. These advances will enable a spectrum of operational capabilities ranging from enhanced management and exploitation of intelligence, surveillance, and reconnaissance assets to next-generation tactical radio systems. Successful implementation of these transformational capabilities will necessitate a corresponding transformation in DoD's ability to test and evaluate Netcentric Systems. The Netcentric Systems Test (NST) focus area will address the T&E scenarios, technologies, and analysis tools required to ensure that operational networked systems delivered to the warfighter provide an assured capability to acquire, verify, protect, and assimilate information necessary for battlefield dominance within a complex netcentric environment.

B. (U) ACCOMPLISHMENTS/PLANNED PROGRAM

	FY 2005	FY 2006	FY 2007
Netcentric Systems Test	0.809		

FY 2005 Accomplishments:

Completed stand up of the Netcentric Systems Test Focus Area as the Information Systems Technology Test (ISTT) focus area with the formation of the working group and initiation of projects identified by the BAA process. The name of this focus area was changed to Netcentric Systems Test to emphasize the warfighting nature of this focus area. Initiated new research efforts in FY 2005 into Test Agent for Testing Command and Control, Decision Support and Intelligent Agents; Tactical-Report Generation Test Bed for C4ISR Systems; and Network Simulation and Analysis Tools (NSAT) for Command, Control, Communications, Computers, Intelligence Surveillance, and Reconnaissance (C4ISR).

FY 2006 Plans: NA

FY 2007 Plans: NA

C. (U) OTHER PROGRAM FUNDING SUMMARY NA

D. (U) ACQUISITION STRATEGY NA