OSD RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

Date: February 2007

APPROPRIATION/ BUDGET ACTIVITY	PE NUMBER AND TITLE
RDT&E/ Defense Wide BA# 2	**0602234D8Z - Lincoln Laboratory Research Program**

Cost ($ in Millions)		FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Total Program Element (PE) Cost		29.762	28.810	29.524	31.401	32.258	31.310	31.722	32.168
P534	Lincoln Laboratory	26.762	25.810	26.613	28.483	29.313	28.384	28.757	29.162
P535	Technical Intelligence	3.000	3.000	2.911	2.918	2.945	2.926	2.965	3.006

A. Mission Description and Budget Item Justification: (U) The Lincoln Laboratory research line program (LL Program) is an advanced technology research and development effort conducted through a cost reimbursable contract with the Massachusetts Institute of Technology (MIT). The LL Program funds innovations directly lead to the development of new system concepts, new technologies, and new components and materials. The LL Program contributed foundation technologies to two systems which received the 2002 Packard Excellence in Acquisition Award: (1) the Bio-aerosol sensing and micro-laser technologies were transferred to industry and are in production for the Joint Biological Defense Sensor (JBPDS), and (2) the Free-space optical communications technologies were used in the GeoLite optical communications satellite demonstration system. The LL Program currently has impact in five core technology thrusts: Persistent Surveillance, Sensor Networking and Decision Support, Fiber Lasers and Directed Energy, Advanced Electronics Technology, and Bio-Chem Defense, with emphasis on detection and identification technology, systems analysis and integration. These innovations are intended to negate the effectiveness of enemy biological and chemical weapons, and include efforts in threat assessment, agent detection, and integrated protection. Specific focus areas include potential threats, including those resulting from the rapidly advancing field of genetic engineering as well as worrisome chemical agents. Emphasis is on the practical integration of chemical and biological defenses in an affordable, large-area protection context, not just as one-of-a-kind solutions.

(U) Supporting these five core technology thrusts is a new work effort titled Technical Intelligence. Technical Intelligence will support detailed understanding of technology advancement in important scientific area and other scientific disciplines such as nanotechnology, directed energy and propulsion. Some details are classified, but one effort, called Global Dialogue on Emerging Science and Technology will be jointly sponsored by DOD, Department of State, and CIA will give very detailed insight in such topics as Software Engineering in India, Nanotechnology in South East Asia, European Laser development, for example. This information will in turn assist in development of U.S. capabilities.

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	29.438	28.975	30.425	32.281
Current BES/President's Budget (FY 2008/2009)	29.762	28.810	29.524	31.401
Total Adjustments	0.324	-0.165	-0.901	-0.880
Congressional Program Reductions		-0.165		
Congressional Rescissions				
Congressional Increases				
Reprogrammings	1.145			

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SBIR/STTR Transfer	-0.821			
Other			-0.901	-0.880

C. Other Program Funding Summary: Not Applicable.

D. Acquisition Strategy: Not Applicable.

E. Performance Metrics: Not Applicable.

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Cost ($ in Millions)		FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
P534	Lincoln Laboratory	26.762	25.810	26.613	28.483	29.313	28.384	28.757	29.162

A. Mission Description and Project Justification: (U) The Lincoln Laboratory program (LL Program) is an advanced technology research and development effort conducted through a cost reimbursable contract with the Massachusetts Institute of Technology (MIT). The LL Program funds advanced research activities that directly lead to the development of new system concepts, new technologies, and new components and materials, with impact in five core technology thrusts:

(U) Persistent Surveillance, with emphasis on revolutionary sensing techniques, algorithms for detecting and recognizing battlefield targets both in the clear and hidden, and high-performance computing to enable rapid prosecution of suspected targets.

(U) Sensor Networks and Decision Support, with an emphasis on developing and integrated a set of advanced technologies to improve the use of sensing to support military decision making.

(U) Fiber Lasers and Directed Energy, including the development of novel lasers and advanced beam-control techniques. The laser efforts focus on developing advanced, more efficient fiber lasers and on combining multiple fiber lasers to allow scaling to high-energy-laser (HEL) power levels

(U) Advanced Electronics Technology, with emphasis on development of materials, devices, and subsystems utilizing microelectronic, photonic, biological, and chemical technologies to enable new system approaches to DoD sensors.

(U) Bio-Chem Defense, including technology, analysis and systems aimed at defeating enemy use of biological and chemical weapons, and includes efforts in agent detection, diagnosis and treatment, and informatics systems.

B. Accomplishments/Planned Program:

Accomplishment/Planned Program Title	FY 2006	FY 2007	FY 2008	FY 2009
Lincoln Laboratory	26.762	25.810	26.613	28.483

FY 2006 Accomplishments:
(U) Radar Technology: Conducted innovative foliage-penetration experiments using the Lincoln Laboratory airborne radar testbed.
(U) Passive Optical Surveillance: Designed a novel read-out array for large-scale infrared focal planes. This read-out will provide direct digital output at each pixel. Began fabrication of the read-out array.
(U) Advanced Ladar: Demonstrated first phase of ultra-high-resolution ladar in the laboratory at modest range. Demonstrated THz detection using detection concept developed in FY 2005. Initiated effort in quantum ladar.

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(U) Advanced Processing: Developed and tested a single-die, integrated radar receiver on a chip. Began development of a digital beamformer. Initiated an effort to develop advanced software tools to take advantage of modern trends in computer hardware, such as tiled processors and novel storage devices.
(U) Multi-Sensor Measurements: Conducted measurements from an airborne platform using a combination of 3D ladar and passive video.
(U) Efforts were conducted in 3 related areas: 1) dynamic command and control (C2) for networked intelligence, surveillance, and reconnaissance (ISR), 2) structured knowledge spaces, and 3) distributed service architecture. In dynamic C2 for networked ISR, completed the cuing experiments begun in FY 2005 and developed scheduling algorithms to allocate sensor collections based on predefined priorities. In structured knowledge spaces, developed software to create a linked map of relationships between raw ISR data, extracted information, and derived knowledge. In distributed service architecture, began to develop a discovery architecture that provides reliable access to ISR data anywhere, even over low-bandwidth, intermittent communications networks.
(U) Advanced Biological and Chemical Agent Threat Assessment: Shifting emphasis to the evolving threat, including the broad class of chemical and toxin Novel Threat Agents, combined with the prospects for modern microbiology. Enabled prioritization and categorization of advanced threats for resource allocation, including countermeasures to current systems.
(U) Biological Agent Sensing: Focused on techniques for preservation and storage of CANARY (Bio-technical program) B-cells for up to six months, which appears achievable with techniques under investigation. Tested automated CANARY in field conditions, establishing Receiver Operating Characteristics (ROCs). Developed mote sensor network for integration of low-cost just-capable sensors.
(U) Chemical Agent Sensing: Exercised chemical sensor testbed for quantitative assessment of sensor approaches, establishing ROC performance metrics. Developed a novel, low-cost early-warning chemical agent sensor that could be used in perimeter defense, based on an inexpensive spectrometer designed to examine the transmitted infrared spectrum from a cooperative thermal source. Completed on-base testing of custom infrared spectrometer for rapid standoff detection of chemical agent plumes over large ranges.
(U) Integrated Solutions: Completed first phase of the HaLT (Hanscom-Lincoln Testbed), a site where advanced sensors, response strategies, filtration, neutralization, and command and control concepts are tested in a realistic setting. Deployed biological and chemical sensors in a portion of laboratory building space, and effected passive and active protection measures to reduce agent exposure. Monitor and track meteorological conditions as well as particulate and chemical vapors, networking the sensors through the command post for both operational evaluation and algorithm development. Developed strategies for decision support system, to aid in real-time course-of-action guidance, for the HaLT and for generic DoD system approaches.

FY 2007 Plan:
(U) Using simulated Intelligence Surveillance Reconnisance (ISR) data from a computer-generated tactical scene, will conduct an integrated lab decision-support demonstration of the technologies developed in FY 2006. Based on the results of this integrated demonstration, will continue and expand developments in dynamic C2 for networked ISR, structured knowledge spaces, and distributed service architecture.
U) Continued working to develop tagging and tracking technologies for counter-terrorism applications. Continued field experiments to characterize signatures of facilities handling explosives and fabricating IEDs or other explosive devices. Continued development of improved photon-counting arrays and related readout circuits, with emphasis on enabling passive imaging ISR applications. Developed four-side-abuttable tiling techniques needed to support very large focal plane arrays for ISR applications. Developed improved process modules for Closed Circuit Display (CCD) imager and rad-hard CMOS imager processes which support unique focal planes being developed for various DoD ISR systems. Continued development of lithographically defined quantum-dot artificial materials for optoelectronic applications. Developed technologies for highly integrated RF front ends, with emphasis on film bulk acoustic resonators and SOI CMOS RF transistors. Investigated potential of cryogenic operation of silicon-on-insulator CMOS for both analog processing and high performance computing applications. Continued development of superconducting technology for application to quantum computation. Developed Si-based modulators and detectors for use in integrated silicon microphotonic systems, for photonic signal processing applications. Developed high-power photodetectors for use in low-noise RF sources, arbitrary waveform generation, and photonically fed transmitters. Demonstrated large-mode-volume, high-power semiconductor lasers for use in active sensing, countermeasures, or UV sources for bio-agent sensors.

FY 2008 Plan:
(U) Passive Optical Surveillance: Complete fabrication of the read-out array and demonstrate the read-out in the laboratory.
(U) Advanced Ladar: Significantly improve the resolution of the ultra-high-resolution ladar to enable phase two measurements in the laboratory. Begin developing multi-element Tetra Hertz (THz)detectors. Demonstrate THz ladar system in laboratory. Begin ladar experiments using quantum-measurement techniques.
(U) Advanced Processing: Refine radar receiver on a chip and complete digital beamformer. Continue advanced software effort by implementing hierarchical storage on tiled processor and demonstrating prototype application kernels.

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(U) Multi-Sensor Measurements: Add additional ladar modalities to optical aircraft system. Conduct coordinated measurements involving radar systems on one aircraft and passive optical and ladar measurements on another aircraft.
(U) Fiber Laser Technology: Demonstrated single-mode propagation in large-diameter microstructure fiber. Demonstrated multi-Watt, diffraction-limited short-pulse fiber lasers for 3D ladar. Extended short-pulse fiber lasers for 3D ladar to eye safe wavelengths appropriate for tactical systems. Developed 1,000-element, electrically addressable VCSEL array.
(U) Beam-Control Technology: Investigated techniques for turbulence compensation using arrays of phased fibers. Developed and tested prototype of novel wavefront sensor. Focused propagation analysis on mitigation of turbulence effects on 3D ladar images.

C. Other Program Funding Summary: Not Applicable.

D. Acquisition Strategy: Not Applicable.

E. Major Performers

Category	Name	Location	Type of Work and Description	Award Date
Labs				
	Headquarters Electronic Systems Center	Hanscom AFB, MA	Funds are provided to LL to support the following five core technology thrust areas:1) Persistent Surveillance2) Sensor Networking and Decision Support3) Fiber Lasers and Directed Energy4) Advanced Electronics Technology5) Bio-Chem Defense	16 NOV 2004
	Headquarters Electronic Systems Center	Hanscom AFB, MA	Funds are provided to LL to support the following five core technology thrust areas:1) Persistent Surveillance2) Sensor Networking and Decision Support3) Fiber Lasers and Directed Energy4) Advanced Electronics Technology5) Bio-Chem Defense	16 NOV 2004

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Cost ($ in Millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
P535 Technical Intelligence	3.000	3.000	2.911	2.918	2.945	2.926	2.965	3.006

A. Mission Description and Project Justification: Technical Intelligence supports five core technology thrusts in a new work effort titled. Technical Intelligence combines efforts in two areas: 1) from the university community through the JASONs (this is not an acronymn) program and 2) through information on the technology maturation and development throughout the rest of the world.

(U) JASONs is a group of approximately 50 appropriately cleared experts who provide detailed independent technical assessment of the most difficult technological problems. JASON members are mostly fully tenured professors in physics, mathematics, engineering, and hold active SCI-level clearances. Output from JASON studies are provided to levels up to the Secretary of Defense and their studies shape programmatic and technical decisions involving literally hundreds of millions of dollars. JASONs were previously funded through university research programs, but their level of technology maturity is appropriate for incorporation into Applied Research.

(U) The technical intelligence program will support collaborative work with the U.S. federal intelligence community on emerging and disruptive technologies, primarily through further development of the Science and Technology Net Assessment studies, which assess a select set of technologies from both a domestic and foreign development perspective. The program will also support collaborative work with international partner nations on emerging and disruptive technology assessments. The technical intelligence program will also support development of tools that enable collaborative analysis of emerging and disruptive technologies.

B. Accomplishments/Planned Program:

Accomplishment/Planned Program Title	FY 2006	FY 2007	FY 2008	FY 2009
Technical Intelligence	3.000	3.000	2.911	2.918

FY 2006 Accomplishments:

(U) The JASON studies and Technical Intelligence are focused in areas critical to national security. JASON studies were focused depending on the area most important in the security environment. For the Technical Intelligence portion, supported detailed understanding of technology advancement in important areas of nanotechnology, directed energy, and so forth. Some details are classified, but one effort, called Global Dialogue on Emerging Science and Technology was jointly sponsored by DOD, Department of State, and CIA. This program sponsored several conferences in countries and technologies of interest. These conferences were completely open, but gave very detailed insight in such topics as Software Engineering in India, Nanotechnology in South East Asia, European Laser development, for example. By funding and carefully targeting these opportunities, the DDR&E is able to better shape the Science & Technology (S&T) program.

FY 2007 Plan:

(U) Continue to focus the JASON studies and Technical Intelligence in areas critical to national security. JASON studies will be focused depending on the area most important in the security environment at the time. For the Technical Intelligence portion, support detailed understanding of technology advancement in important areas of nanotechnology, directed energy, and so forth. Some details are classified, but one effort, called Global Dialogue on Emerging Science and Technology will be jointly sponsored by DOD, Department of State, and CIA. This program will sponsor 4-5 conferences in countries and technologies of interest. These conferences will be completely open, but will give very detailed insight in such topics as Software Engineering in India, Nanotechnology in South East Asia, European Laser development, for example. By funding and carefully targeting these opportunities, the DDR&E will be able to better shape the S&T program.

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FY 2008 and 2009 Plans:
(U) Continue to focus the JASON studies and Technical Intelligence in areas critical to national security. JASON studies will be focused depending on the area most important in the security environment at the time. For the Technical Intelligence portion, support detailed understanding of technology advancement in important areas of nanotechnology, directed energy, and so forth. Some details are classified, but one effort, called Global Dialogue on Emerging Science and Technology will be jointly sponsored by DOD, Department of State, and CIA. This program will sponsor 4-5 conferences in countries and technologies of interest. These conferences will be completely open, but will give very detailed insight in such topics as Software Engineering in India, Nanotechnology in South East Asia, European Laser development, for example. By funding and carefully targeting these opportunities, the DDR&E will be able to better shape the S&T program.

C. Other Program Funding Summary: Not Applicable.

D. Acquisition Strategy: Not Applicable.

E. Major Performers Not Applicable.