OSD RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2008

APPROPRIATION/ BUDGET ACTIVITY	PE NUMBER AND TITLE
RDTE, Defense Wide BA 02	**0602234D8Z - Lincoln Laboratory**

	COST ($ in Millions)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	27.962	29.269	31.340	31.954	31.003	31.417	31.860
P534	Lincoln Laboratory	24.962	26.358	28.427	29.037	28.106	28.481	28.883
P535	Technical Intelligence	3.000	2.911	2.913	2.917	2.897	2.936	2.977

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.

(U) The LL Program currently has 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 Networking 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.

(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, with emphasis on detection and identification technology, systems analysis and integration.

(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 2007	FY 2008	FY 2009
Previous President's Budget (FY 2008)	28.810	29.524	31.401

Current BES/President's Budget (FY 2009)	27.962	29.269	31.340
Total Adjustments	-0.848	-0.255	-0.061
Congressional Program Reductions		-0.255	
Congressional Rescissions			
Congressional Increases			
Reprogrammings			
SBIR/STTR Transfer	-0.791		
Other	-0.057		-0.061

C. Other Program Funding Summary Not applicable for this item.

D. Acquisition Strategy Not applicable for this item.

E. Performance Metrics: Not Applicable.

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RDTE, Defense Wide BA 02	**0602234D8Z - Lincoln Laboratory**	**P534**

COST ($ in Millions)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
P534 Lincoln Laboratory	24.962	26.358	28.427	29.037	28.106	28.481	28.883

A. Mission Description and Budget Item 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:

Accomplishments/Planned Program Title:	FY 2007	FY 2008	FY 2009
Lincoln Laboratory	24.962		

FY 2007 Accomplishments:
(U) Passive Optical Surveillance: Completed fabrication of the read-out array and demonstrate the read-out in the laboratory.
(U) Advanced Ladar: Significantly improved the resolution of the ultra-high-resolution ladar to enable phase 2 measurements in the laboratory. Began developing multi-element THz detectors. Demonstrated THz ladar system in laboratory. Began ladar experiments using quantum-measurement techniques.
(U) Advanced Processing: Refined radar receiver on a chip and complete digital beamformer. Continued advanced software effort by implementing hierarchical storage on tiled processor and demonstrating prototype application kernels.
(U) Multi-Sensor Measurements: Added additional ladar modalities to optical aircraft system. Conducted coordinated measurements involving radar systems on one aircraft and passive optical and

ladar measurements on another aircraft.
(U) Decision Support: Used simulated 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) Fiber Laser Technology: Scaled arrays of short-pulse fibers to higher powers for longer-range ladar systems. Developed arrays of VCSELs at 1.5µm wavelengths compatible with fiber communications systems. 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. Field tested beam control using low-power fiber array. Developed and test novel wavefront sensor in pulsed mode appropriate to HEL systems such as the Airborne Laser (ABL).
(U) Advanced Electronics Technology: Developed prototype passive photon-counting arrays scaleable to large pixel counts, to enable a new class of ISR sensors. Developed improved photon counting detectors useable in the short-wave to mid-wave IR region for remote sensing applications. Continued development efforts on semiconductor processes enabling four-side-abuttable imaging tiles for gigapixel focal planes, needed for large field-of-view persistent surveillance, using three-dimensionally integrated detectors and mixed-signal readout circuits. Developed new techniques for detecting and pre-empting terrorist activity, with emphasis on tagging, tracking, and locating technologies and miniaturized low-power, long endurance microsensors. Developed technologies for highly integrated RF front ends, including silicon-based transceivers for use in low-cost and reconfigurable RF systems. Conducted research on failure mechanisms and reliability of high-brightness diode lasers and compound-semiconductor detectors needed for DoD remote sensing systems. Developed silicon-based photonic technology, integrable with silicon CMOS, for applications to analog photonics and phased-arrays. Continued development of solid state and semiconductor laser illuminators for laser radars, low-cost bioaerosol sensors, and high power laser applications. Investigated device technologies for future high performance computing applications, including cryogenic approaches to classical and quantum computation. Continued efforts to transition technology to a wide range of DoD system demonstrations, and to industry for volume manufacturing.
(U) Advanced Biological and Chemical Agent Threat Assessment: Developed specific approaches for sensing requirements to address current vulnerabilities or mitigation strategies. Novel detection schemes were incorporated into existing systems, and extended to methods for tagging or tracking stock components or potential protection concepts.
(U) Biological Agent Sensing: Addressed technology development and evaluation to meet the sensing needs of the military and homeland defense communities. Improved CANARY detect-to-warn sensor, emphasizing cell logistics and false positive rate. Established new methodologies for sensor testing.
(U) Chemical Agent Sensing: Applied testbed and resources to comparative testing of emerging chemical sensing technologies. Modeled and developed simulants for current and emerging chemical agent challenges, interferents and backgrounds. Deployed novel, early-warning perimeter chemical agent sensor and custom infrared spectrometer in HaLT and at a remote site.
(U) Integrated Solutions: Expanded HaLT to encompass a larger portion of Hanscom AFB, adding perimeter-monitoring and/or early-warning chemical and biological sensing capability. Expanded mote sensor network and focus on a demonstration of network utility in release detection and tracking. Explored alternative architectures involving sensing and HVAC control as well as other proactive and response strategies such as portal screening.

Accomplishments/Planned Program Title:	FY 2007	FY 2008	FY 2009
Lincoln Laboratory		26.358	28.427

FY 2008 and 2009 Plans:
(U) Passive Optical Surveillance: Scale up size of digital focal-plane array and incorporate in imager.
(U) Advanced Ladar: Demonstrate ultra-high-resolution 3D optical SAR imaging. Begin outdoor experiments with THz ladar. Continue ladar experiments using quantum-measurement techniques.
(U) Advanced Processing: Explore integration of radar receiver on a chip in arbitrary-beams, hyper-mode system. Demonstrate integrated tile and storage processor for particular application.
(U) Multi-Sensor Measurements: Incorporate real-time processing and data links to allow cross-cuing among multiple sensor platforms
(U) Decision Support: Demonstrate an integrated multi-source information /knowledge management architecture to provide decision support for a simulated military intelligence application.
(U) Fiber Laser Technology: Scale up power of short-pulse, eye-safe fiber lasers for 3D ladar systems. Develop VCSEL technology to support high peak power.

(U) Beam-Control Technology: Develop phased-array imaging capability to support phasing of fiber arrays.
(U) Advanced Electronics Technology: Develop technologies for focal planes which enable new approaches to DoD electro-optical sensors, with emphasis on improved photon-counting arrays and related readout circuits, three-dimensionally integrated detectors and mixed-signal readout circuits, and unique designs and processes for ultra-low power operation, high data collection rates, or operation in stressing environments. Continue work on the development of gigapixel tiled focal planes. Develop new techniques for detecting and pre-empting terrorist activity. Develop technologies for highly integrated RF front ends, including silicon-based transceivers for use in low cost and reconfigurable RF systems. Continue development of advanced electro-optical and cell-based bio-defense sensors. Continue development of solid state and semiconductor laser illuminators for active sensing, countermeasures, and high power laser applications. Develop new approaches to electronic devices to allow continued scaling and performance improvements for defense and commercial electronics. Continue activities to provide increased hardness, countermeasure resistance, and anti-tamper capability for U. S. military systems.
(U) Advanced Threat Assessment: New projects will (1) continue analytical efforts, (2) understand better how agent fate and transport affects realistic bio threats and vulnerabilities, and (3) consider modes of attack other than aerosol.
(U) Biological Agent Sensing: Test CANARY in field conditions with varied backgrounds. Continue to promulgate use of ROC curves for fair comparison among sensors. Move beyond current industry testing approaches that are largely threshold event driven.
(U) Chemical Agent Sensing: Pursue new approaches to chemical line and standoff sensing, emphasizing the need for earliest warning at the lowest cost. Integrate with biosensing with similar goals.
(U) Integrated Solutions: Utilize HaLT as a testbed for integration and performance comparison of government-supplied sensors and protection equipment. Explore new strategies for response to potential attack.

C. Other Program Funding Summary Not applicable for this item.

D. Acquisition Strategy Not applicable for this item.

E. Major Performers

Category	Name	Location	Type of Work and Description	Award Date
Labs/Centers				
	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	Nov 04
	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	Nov 04

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COST ($ in Millions)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
P535 Technical Intelligence	3.000	2.911	2.913	2.917	2.897	2.936	2.977

A. Mission Description and Budget Item Justification: Technical Intelligence supports five core technology thrusts that combine efforts in two areas: 1) from the university community through the JASONs (this is not an acronymn) program and 2) through information on maturation and of technology 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:

Accomplishments/Planned Program Title:	FY 2007	FY 2008	FY 2009
Technical Intelligence	3.000	2.911	2.913

FY 2007 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 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 for this item.

D. Acquisition Strategy Not applicable for this item.

E. Major Performers Not applicable for this item.