Exhibit R-2, RDT&E Budget Item Justification							Date: February 2005	
Appropriation/Budget Activity RDT&E., Defense-Wide BA2				R-1 Item Nomenclature: Lincoln Laboratory 0602234D8Z				
Cost ($ in millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Total PE 0602234D8Z Cost	25.945	24.846	29.914	30.493	31.887	31.715	32.296	32.960
Lincoln Laboratory **P534**	25.945	24.846	26.914	27.493	28.887	28.715	29.296	29.960
Technical Intelligence **P535**	0.000	0.000	3.000	3.000	3.000	3.000	3.000	3.000

A. Mission Description and Budget Item Justification:

(U) The Lincoln Laboratory (LL) Line program is an advanced technology research and development effort conducted through a cost reimbursable contract with the Massachusetts Institute of Technology (MIT). LL is operated as an FFRDC administered by the DoD, and is unique among DoD FFRDC's: the laboratory is operated (under A-21) by MIT with no fee. Thus, the Research Line is the laboratory's only dedicated source of funding for innovative research and development efforts.

(U) The LL Line funds advanced research activities that directly lead to the development of new system concepts, new technologies, and new components and materials. These activities enable the DoD to address latent technology needs that affect a broad spectrum of missions, services, and transformational operational capabilities. The Lincoln Laboratory Research Line 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 GeoLite demonstration provides the underpinnings of the Transformation Communications Architecture. Other recent successes include a compact 3D imaging laser radar that uses unique photon-counting avalanche photodiode arrays and has demonstrated, in the DARPA Jigsaw program, high quality imagery of targets obscured by dense foliage or camouflage, and a biosensor that uses genetically engineered immune cells and has demonstrated the ability to identify major bio-warfare agents in under two minutes with high sensitivity and low false alarm rate.

(U) The LL Line program currently has impact in five core technology thrusts:

(U) Surveillance Systems and Decision Support, with emphasis on revolutionary sensing techniques, algorithms for detecting and recognizing battlefield targets both in the clear and in difficult deployments, and high performance computing to enable rapid prosecution of suspected targets. The advanced sensing techniques include simultaneous multi-mode operation to improve the ability to monitor multiple ground surveillance sites.

These improvements are complemented with innovations in algorithm techniques to efficiently extract information from multi-modalities operation. Develop signal processing computing architectures to respond in real-time on-board the sensor platform. The multi-modality sensing is fused with archived data to improve target ID and classification. These techniques will enable dramatic improvements in ground surveillance targeting, identification and classification.

(U) Communications and Networks, with emphasis on high bandwidth, low probability of intercept, jam resistant communication links and machine-to-machine applications that operate over a network of these links. Links include advanced antenna designs, RF technology, and high-rate fiber and free-space optical communications systems. Develop network protocols (including for mobile users with lightweight transceivers) for "socketing" sensors into the network and the interconnection of these very disparate modalities into a global defense network that can truly realize the vision of a "from sensor to decider to shooter" communications infrastructure. Develop unique intrusion detection/response techniques to protect computer networks and applications that fuse information for presentation to decision makers.

(U) Applied Optics, including advanced 3D laser radars (ladars), high-energy-laser (HEL) technology, and active and passive hyper spectral imaging (HSI). The ladar efforts develop and test advanced concepts in both 3D direct detection ladar and in coherent ladar. These ladar efforts are providing the enabling technology for a variety of new DoD systems, including target identification systems as part of the Army Future Combat Systems (FCS) and discrimination systems for advanced ballistic-missile-defense (BMD) seekers. The HEL technology efforts focus on improving beam control for stressing atmospheric conditions (e.g., tactical HELs in near-surface engagements) and on developing novel, more efficient lasers to reduce the size and weight of future HEL systems. The HEL efforts will potentially enable future HEL systems, such as Block upgrades to the Airborne Laser (ABL) and an Advanced Tactical Laser with a solid-state laser as the weapon laser. The HSI efforts have been principally focused on active sensing and the combining of HSI sensing with ladar sensing.

(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. Specific focus areas include work on high performance focal plane arrays such as 3-D imaging and photon-counting arrays for ISR and advanced missile seekers, high efficiency, high brightness semiconductor lasers for active illuminators, countermeasures, and other directed energy applications, new sensors for rapidly detecting and identifying low concentrations of bio-warfare agents, components for miniaturized RF systems for electronic intelligence and communications, and high-speed, radiation hard, ultra-low power analog and digital circuits tailored for DoD applications.

(U) Bio-Chem Defense, including technology, analysis and systems aimed at defeating enemy use of biological and chemical weapons, and including efforts in agent detection, diagnosis and treatment, and informatic systems. Agent detection is aimed at rapid, accurate, and sensitive methods for collecting, analyzing and reporting the presence of biological and/or chemical agents, and involves analysis of chemical and physical properties of the agents, such as DNA, RNA, antigens and various other proteins. Both stand-off (remote) detection and point sensing are included. Treatment methodologies include novel anti-microbial techniques that open new immune-system pathways for biological-warfare agent-induced diseases that might otherwise be untreatable. Bioinformatics systems are specifically targeted at the analysis of micro array images, applying first to

pattern recognition techniques for agent identification, but expanding into large integrated systems.

(U) Supporting these five core technology thrusts is a new work effort titled Technical Intelligence. Technical Intelligence combines efforts in two areas: 1) from the university community through the JASONs program and 2) through information on the technology maturation and development throughout the rest of the world.

1. (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.

2. (U) 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 US capabilities.

B. Program Change Summary:

	FY 2004	FY 2005	FY 2006	FY 2007
Previous President's Budget:	26.830	25.441	26.854	27.367
Current FY 2006 President's Budget Submission:	25.945	24.846	29.914	30.493
Adjustments to Appropriated Value:	-0.885	-0.595	+3.060	+3.126
Congressional Program Reductions:	-0.204	-0.595		
Congressional Rescissions:				
Congressional Increases:				
Reprogrammings:				
SBIR/STTR Transfers:	-0.681			
Other:				
Program Increase:			+3.060	+3.126

C. Other Program Funding Summary: N/A

D. Acquisition Strategy: N/A

E. Performance Metrics: (U) Performance in the Lincoln Laboratory program is managed with a sustained and agile focus on matching emerging technology opportunities to latent national security needs. As a DoD FFRDC, Lincoln Laboratory is focused on increasing the Technology Readiness Level (TRL) of the applicable enabling technologies to support critical new DoD capabilities. An essential element of a sustained thrust is the demonstration of new systems capability in relevant (field) environments. Each thrust is structured to bring the new capability up to the TRL 5-6 range. At the same time, continuing adaptation of the emerging enabling technologies (at the TRL 2-3) assures that the critical national systems expertise is enhanced and sustained, so that additional innovations can quickly be transitioned to the services and industry as rapidly as possible. Performance in the Technical Intelligence program is managed to produce results in two areas: 1) timely advice from seasoned, tenured university representatives through the JASONs program and 2) critical insight on the technology maturation and development throughout the rest of the world.

Exhibit R-2a, RDT&E Project Justification							Date: February 2005	
Appropriation/Budget Activity RDT&E, Defense-Wide BA2				Project Name and Number Lincoln Laboratory 0602234D8Z				
Cost ($ in millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Lincoln Laboratory **P534**	25.945	24.846	26.914	27.493	28.887	28.715	29.296	29.960

A. Mission Description and Budget Item Justification:

(U) The Lincoln Laboratory (LL) Line program is an advanced technology research and development effort conducted through a cost reimbursable contract with the Massachusetts Institute of Technology (MIT). The LL Line 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) Surveillance Systems and Decision Support, with emphasis on revolutionary sensing techniques, algorithms for detecting and recognizing battlefield targets both in the clear and in difficult deployments, and high performance computing to enable rapid prosecution of suspected targets.

(U) Communications and Networks, with emphasis on high bandwidth, low probability of intercept, jam resistant communication links and machine-to-machine applications that operate over a network of these links

(U) Applied Optics, including advanced 3D laser radars (ladars), high-energy-laser (HEL) technology, and active and passive hyper-spectral imaging (HSI).

(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 informatic systems.

B. Accomplishments/Planned Program

Surveillance Systems & Decision Support	FY 2004	FY 2005	FY 2006	FY 2007
Accomplishment/ Effort/Subtotal Cost	6.605	5.419	5.874	6.000

FY 2004 Accomplishments:

(U) Advanced High Performance Computing Technologies: Integrated wideband Very Large Scale Integrated (VLSI) channelized receiver with electronically-scanned phased array antenna to demonstrate Space-Based Radar Electronic Counter-Countermeasures (ECCM) and signal processing functionality.

(U) Surface Surveillance Phased Array System: Built several channels of advanced conformal phased-array architecture for airborne and space-based Ground Surveillance radars, and demonstrated improvements in time-energy utilization using mode interleaving and multiple simultaneous beam formation. Characterized and quantified sensor performance to detect targets in the presence of high levels of ground clutter and other signal interferers.

(U) Array Element Level Digitization: Developed innovative architectures to enable digitization at the element level. Integrated digital signal processor with radiating antenna manifold. These architectures eliminate the existing complexity present with more conventional analog hardware architecture.

(U) UAV Video Exploitation: Developed video processing algorithms to process large amounts of video data from Unmanned Air Vehicles (UAVs) presently overloading image analysts and precluding fast turn around responses. Rapid confirmation of suspected targets was enabled by correlating multiple frames to quickly identify mobile threats within a 3-D scene under surveillance.

(U) Parallel and Distributed Processing: Developed techniques to implement signal processing algorithms across a number of heterogeneous computing platforms. Demonstrated unique approaches on small cluster of computing nodes. Transitioned technology to a grid of cluster of computers to facilitate rapid prototyping on ground and airborne platform.

FY 2005 Plans:

(U) Surface Surveillance Phased Array System: Demonstrate prototype system instrumented on-board of a sensor platform. Apply advanced signal processing algorithms to collected data to verify predicted performance.

(U) Array Element Level Digitization: Develop hardware design and build concept hardware with key enabling technologies. Begin demonstration on a sub-scale prototype.

(U) UAV Video Exploitation: Demonstrate video processing algorithms based on representative scenario data. Quantify improvements compared to today's conventional approaches. Implement algorithms in real-time on-board an experimental Navy airborne sensor platform.

FY 2006 Plans:

(U) Surface Surveillance Phased Array System: Demonstrate prototype system instrumented on-board of a sensor platform. Apply advanced signal processing algorithms to collected data to verify predicted performance. Demonstrate revolutionary improvements in simultaneous sensing leveraging multiple ISR functions from the same array.

(U) Array Element Level Digitization: Develop hardware design and build concept hardware with key enabling technologies. Begin demonstration on a sub-scale prototype.

(U) UAV Video Exploitation: Demonstrate video processing algorithms based on representative scenario data. Quantify improvements compared to today's conventional approaches. Implement algorithms in real-time on-board an experimental Navy airborne sensor platform.

FY 2007 Plans:

(U) Surveillance Systems: Demonstrate enabling technologies to permit simultaneous sensing from single sensor and the network centric exploitation of ISR data together with video processed inputs. The multi-sensor capabilities will address the critical problem of detecting, identifying and prosecuting time critical targets. These capabilities will lead to a real-time performance. New algorithms will be verified with real data from experimental platforms.

Communications & Networks	FY 2004	FY 2005	FY 2006	FY 2007
Accomplishment/ Effort/Subtotal Cost	2.377	1.067	1.156	1.181

FY 2004 Accomplishments:

(U) Global Networks: Refined the architecture and technology for global high-rate military communications to permit seamless line-of-sight and over-the-horizon connectivity for peer-to-peer computer-based tactical applications to include distributed operations centers, distributed sensor ground processing, and integrated C2 of reconnaissance and strike assets. Technologies include moving to a "packet-based" network design, redesigning crypto and transec to retain Information Assurance in a packet topology, revising network control via a "Connectivity Broker" to provide both tactical on-demand connectivity and transient provisioning of large data pipes for sensor flows with predictive connection topology change rather than just reactive change.

(U) Defensive Information Warfare: Focused on the problems of robustness and security of collaborative applications, including chat, against information attacks and varying link availability in an airborne C4ISR environment. Developed new chat application software with linked but independent chat servers on airborne platforms; tested with good initial results in JEFX-04.

(U) Airborne C2 Node: Used the Air Force Paul Revere Test bed to test new communications, command, and control concepts for ISR and for interface to strike, including the electronic threat environment as influenced by Electronic Countermeasures (ECM) and jamming. Extend multi-INT system to include ID sensors, and use experimental system to form a substrate for the time-critical strike lattice. Developed cueing strategies and use of contextual information in behavior databases.

FY 2005 Plans:

(U) Global Networks: Continue to develop, demonstrate, and transfer technologies for high speed optical and RF networked communications into funded DoD programs that put global connectivity into the hands of the war fighter. Extend "Connectivity Broker" concept to optimize use of both narrow-band and wideband tactical links to maximize network throughput in air- and ground-mobile environments, taking into account time-varying user traffic connectivity demands.

(U) Defensive Information Warfare: Continue focus on tactical ISR used to support joint air-sea and air-land networks, working the wired and wireless robustness and security issues facing net-centric warfare, with attention to robustness for collaborative applications. Develop techniques for secure authentication of distributed users in collaborative environments on fragile tactical networks

(U) Airborne C2 Node: Continue use of the Air Force Paul Revere Test bed to exploit Global Airspace Traffic Management data to enhance the air picture; provide computer-to-computer network interfaces to the Navy Cooperative Engagement assets; and to provide firepower support to transformational army elements. Optimize ability of "Connectivity Broker" to increase throughput in these complex, time-varying network topologies. Extend system to include multiple synoptic and narrow field-of-view sensors such that the system provides the mechanism of linking sensors in the reconnaissance/strike lattice. Transfer technology to BMC2 contractor for use in Command Air Operations Center (CAOC), Distributed Common Ground Station (DCGS) and Multi-mission Command and Control

Aircraft (MC2A).

FY 2006 Plans:

(U) Global Networks: Continue to develop, demonstrate, and transfer technologies for high speed optical and RF networked communications into funded DoD programs that put global connectivity into the hands of the war fighter.

(U) Defensive Information Warfare: Continue focus on tactical ISR used to support joint air-sea and air-land networks, working the wired and wireless robustness and security issues facing net-centric warfare, with attention to robustness for collaborative applications.

(U) Airborne C2 Node: Use the Air Force Paul Revere Test bed to exploit Global Airspace Traffic Management data to enhance the air picture; provide computer-to-computer network interfaces to the Navy Cooperative Engagement assets; and to provide firepower support to transformational army elements. Extend system to include multiple synoptic and narrow field-of-view sensors such that the system provides the mechanism of linking sensors in the reconnaissance/strike lattice. Transfer technology to BMC2 contractor for use in Command Air Operations Center (CAOC), Distributed Common Ground Station (DCGS) and Multi-mission Command and Control Aircraft (MC2A).

FY 2007 Plans:

(U) Continue to develop, demonstrate, and transfer technologies for high speed optical and RF networked communications in support of military operations, particularly in the tactical theater. This includes work to protect these essential networks, and the collaborative user applications that run over them, particularly in the networks that support C2ISR connectivity among sensors, deciders, and shooters.

Applied Optics	FY 2004	FY 2005	FY 2006	FY 2007
Accomplishment/ Effort Subtotal Cost	5.179	3.816	4.136	4.225

FY 2004 Accomplishments:

(U) Laser Radar: Achieved a significant milestone with the first-ever demonstration of photon-counting coherent detection. This milestone enables the development of multi-function laser-radar systems, which combine 3-D imaging and range-Doppler sensing, for applications to BMD interceptors, combat identification, and foliage penetration. These systems use the same laser transmitter and the

same photon-counting avalanche photodiode (APD) array for both direct-detection laser radar for 3D imaging and coherent laser radar for range-Doppler imaging. Completed the development of a Geiger-mode avalanche photodiode array sensitive at 1 μm. Fielded this array in a 3D ladar system.

(U) High Energy Laser (HEL) Technology: Conducted lab experiments to demonstrate the utility of multi-conjugate adaptive-optics (MCAO) for atmospheric compensation. MCAO should potentially provide improve HEL system performance in stressing propagation scenarios and in relay-mirror scenarios. A new lab experiment was implemented to explore non-linear phase conjugation and initial results were obtained. The Slab-Coupled Optical Waveguide Laser (SCOWL) laser demonstrated the highest brightness ever out of a diode laser. A novel fiber-laser for scaling to very high power was designed and fabricated

(U) Hyper Spectral Imaging (HSI): An HSI system for combined HSI/ladar measurements was designed and fabricated.

FY 2005 Plans:

(U) Laser Radar: Continue to develop multi-function laser-radar systems for applications in advanced ballistic and tactical seekers, surface surveillance, and combat identification to demonstrate operational form, fit, and function. This includes efforts at electronics miniaturization using Application Specific Integrated Circuits (ASIC) components to generate systems that show a direct development path to fit on a seeker, hand carried sensor, or small UAV. Initiate development of ultra-high-resolution ladar for applications such as long-range face recognition.

(U) High Energy Laser Technology: Continue MCAO and nonlinear-phase-conjugation efforts with particular emphasis on thermal-blooming compensation. Continue the exploration of real-time decision aids to help optimize the performance of HELs in varying atmospheric conditions. Continue modeling and simulation work with the ultimate goal of developing a complete “photon birth-to-death” model. Test microstructure fiber laser. Demonstrate combined spectral and coherent beam combining for high-power fiber lasers.

(U) Hyper-Spectral Imaging: Install the HSI system developed in FY 2004 on an aircraft and take simultaneous measurements with the HSI system and with a 3D ladar system. Develop algorithms to combine the two different kinds of data.

FY 2006 Plans:

(U) Laser Radar: Demonstrate a miniaturized multi-function ladar. Continue development and lab testing of ultra-high-resolution ladar.

(U) High Energy Laser Technology: Test new compensation algorithms in the lab. Complete “photon birth-to-death” model. Scale up

power level for hybrid—spectral and coherent—beam combining for fiber lasers. Implement a proof-of-principle real-time decision aid.

(U) Hyper-Spectral Imaging: Expand combined HSI and ladar experiments by incorporating extended wavebands in the HSI system.

FY 2007 Plans:

(U) Demonstrate an ultra-high-resolution ladar in field tests. Perform atmospheric propagation and beam control tests with a beam-combined fiber-laser system. Continue critical technology development to enable fiber-laser systems to scale to very high powers.

Advanced Electronics Technology	FY 2004	FY 2005	FY 2006	FY 2007
Accomplishment/ Effort Subtotal Cost	6.605	7.100	7.678	7.843

FY 2004 Accomplishments:

(U) Continued development of photon-counting focal plane technologies with emphasis on larger array sizes, smaller pixels, new concepts for per-pixel electronics, and longer wavelength response, for ISR and seeker applications. Developed silicon-on-insulator-based process technologies for 3-D integration to build smart focal planes and high-clock-rate low-power digital processing functions, and demonstrated working circuits using three vertically interconnected silicon layers. Developed technologies for advanced focal planes which allow 2-D tiling of large arrays. Demonstrated new process for small-pixel size CCDs capable of scene jitter removal. Designed and simulated ultra-low-noise imager readout structure for use in low-light and high-frame-rate imaging. Developed component integration technologies including integrated passives and frequency control elements, silicon active RF components, and MEMs switches, enabling low-cost, miniaturized receiver-on-a-chip and receiver-in-a-package solutions tailored to DoD applications. Developed low-loss hermetic packaging for RF MEMs for millimeter-wave systems. Completed design and demonstration of a pre-prototype video micro-sensor being developed for long endurance unattended ground sensors. Continued work to extend the scaling of integrated circuits to nanometer dimensions, including emerging techniques such as molecular electronics. Demonstrated a new approach for efficient UV generation for bio-aerosol sensors. Developed component technologies for analog photonic systems. Continued our technology transfer efforts to industry.

FY 2005 Plans:

(U) Develop improved photon-counting arrays and related readout circuits, for both active illumination and passive imaging applications. Extend photon counting detector performance further into the near- and mid-wave IR spectral region. Develop three-

dimensionally integrated detectors and mixed-signal readout circuits. Develop technologies for highly integrated RF front ends, with emphasis on film bulk acoustic resonators and SOI CMOS RF transistors. Develop technologies for long endurance micro-sensors. Investigate potential of cryogenic operation of silicon-on-insulator CMOS for both analog processing and high performance computing applications. Continue development of advanced electro-optical and cell-based bio-defense sensors. Investigate approaches for improving detection of explosives. 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 our efforts to transition technology to a wide range of DoD system demonstrations, and to industry for volume manufacturing.

FY 2006 Plans:

(U) 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. 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 our efforts to transition technology to a wide range of DoD system demonstrations, and to industry for volume manufacturing.

FY 2007 Plans:

(U) Develop micro system technologies enabling new approaches to DoD sensor systems, with emphasis on advanced focal planes, highly integrated RF electronics, technologies for unattended ground sensors, lasers for active imaging, countermeasures, and directed energy applications, and chemical and biological agent sensors. Develop new device concepts and process technologies, enabling continued scaling of microelectronic devices, lower cost, higher performance, and lower power operation. Transfer technologies to industry, both for specialized DoD systems as well for commercially important dual-use applications.

Bio-Chem Defense	FY 2004	FY 2005	FY 2006	FY 2007

Accomplishment/ Effort Subtotal Cost	5.179	7.444	8.069	8.243

FY 2004 Accomplishments:

(U) Bio and Chem Agent Detection Systems: Tested the combined BAWS-CANARY in chambers with simulants and in realistic outdoor conditions under a variety of backgrounds, resulting in the production of Receiver Operating Characteristics (ROC) curves for a trigger-identifier system for the first time. Initiated new efforts in improving logistics of CANARY sensor, particularly addressing cell lifetime in storage and handling. Demonstrated CANARY (normally used on antigens) can be used to detect and identify DNA. Concluding effort in trapping, manipulating and analyzing individual bio-aerosol particles. Initiated efforts aimed at taking advantage of bacterial cell signaling as a sensor modality.

(U) Diagnosis and Treatment: Expanded exploration of chemical signatures of bacteria in the breath, looking for new exhalants, by applying techniques in hospital setting with real samples. Collected ambient disease agent backgrounds in hospital conditions, anticipating next year's flu season. Transitioned work on anti-viral therapies into broader-based antimicrobials.

(U) Bioinformatics: Concluding efforts in applying automated target recognition techniques to micro-array data and images, working toward building a pathogen signature data base.

(U) Facility Defense: Initiated efforts aimed at neutralizing agents in ventilation systems, utilizing aerosol chamber and germicidal ultraviolet light. Conducted tests in post-attack exposure assessment under realistic indoor and outdoor conditions. Explore defense of potable water systems through test bed approach.

FY 2005 Plans:

(U) Agent Detection Systems: Based on data from field trials, improve upon BAWS-CANARY sensor, and continue tests under varied background conditions. Continue efforts in improving response and logistics of CANARY sensor, emphasizing dried-cell techniques. Conclude efforts aimed at taking advantage of bacterial cell signaling as sensor modality. Will collect background hospital environmental data during flu season to see if detectable on surfaces. Advanced standoff sensing designs employing simple bi-static components are to be considered. Establish new methodologies for sensor testing, moving beyond current industry approaches that are largely threshold event driven. Promulgate use of ROC curves as method of fair comparison among sensors.

(U) Analysis and Modeling: Develop advanced models for biological and chemical sensors. Develop and incorporate additional analytical tools in disease progression, fluid dynamics, distribution modeling (of food). Develop predictive strategies that can be employed at special events. Understand better how agent fate and transport affects realistic bio threats and vulnerabilities.

(U) Facility Defense: Establish test beds for defense against bio and chem attack. Explore alternative architectures involving sensing and HVAC control as well as other proactive and response strategies such as portal screening. Incorporate results from FY04 on the use of ultraviolet light as neutralization approach. Continue to explore defense of potable water systems, taking advantage of inherent system latencies. Develop and employ command and control models for protection systems.

FY 2006 Plans:

(U) Agent Detection Systems: Pursue new compact, affordable designs for BAWS-CANARY sensor, and conduct field tests. Conclude efforts in logistics of CANARY sensor, emphasizing dried-cell techniques. Finalize standoff sensing designs employing simple bi-static components and employ in limited field tests. Continue to develop sensor testing methodologies, and apply to a number of in-house as well as industry-based sensors. Continue to promulgate use of ROC curves as method of fair comparison.

(U) Analysis and Modeling: Apply advanced models for biological and chemical sensors. Continue to develop, incorporate and integrate analytical tools in disease progression, fluid dynamics, distribution modeling (of food, water, etc.). Apply predictive strategies that can be employed at special events. Through continued measurements, understand better how agent fate and transport affects realistic bio threats and vulnerabilities. Compare data with predictions.

(U) Facility Defense: Employ test beds aimed at defense against bio and chem attack in air, food and water. Continue to explore alternative architectures involving sensing and HVAC control as well as other proactive and response strategies such as vehicle screening and standoff detection. Incorporate newly developed techniques for agent neutralization. Test advanced command and control models in protection systems.

FY 2007 Plans:

(U) Build and field new designs for BAWS-CANARY, utilizing results from cell drying efforts. Also field bi-static components in more formal field trials. In all cases collect data sufficient for ROC curves. Based on analysis and modeling efforts, establish predictions of component performance and compare with data. Translate these efforts into larger system-based solutions, to involve both chemical and biological defense measures. Employ advanced command and control architectures in realistic situations.

Exhibit R-2a, RDT&E Project Justification							Date: February 2005	
Appropriation/Budget Activity RDT&E, Defense-Wide BA2				Project Name and Number Lincoln Laboratory 0602234D8Z				
Cost ($ in millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Technical Intelligence **P535**	0	0	3.000	3.000	3.000	3.000	3.000	3.000

A. Mission Description and Budget Item Justification:

(U) The Technical Intelligence Line reflects the DoD need for timely advice from seasoned, tenured university representatives:

(U) Technical Intelligence is a research area that will combine the work of academia and international work to focus the Department's future work.

(U) Supporting these five core technology thrusts is a new work effort titled Technical Intelligence. Technical Intelligence combines efforts in two areas: 1) from the university community through the JASONs program and 2) through information on the technology maturation and development throughout the rest of the world.

1. (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.

2. (U) 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 US capabilities.

B. Accomplishments/Planned Program

FY 2004 Accomplishments:

(U) Until 2002, the JASON program was funded as a separate project under the Defense Advanced Research Projects Agency. In

2002, the program was transferred, by the Under Secretary of Defense (AT&L) to the Director, Defense Research and Engineering and was covered outside this PE. JASON studies in 2004 include: Technical approach to Horizontal Integration (joint DoD – CIA study to increase interoperability); Improvised Explosive Device Technology Options; Thermal Management (to allow battlefield lasers); Tagging, Tracking, and Locating High Value Targets (Classified); Theoretical Limits on Remote Sensing Chemical Weapons; Intelligent Application of Aspherical Optics (Next generation reconnaissance); Feasibility of Large Deployable Space Telescopes; and about 10 other studies. 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. For the other portion of Technical Intelligence, nothing was accomplished as the program was not in existence yet.

FY 2005 Plans:

(U) Continue to focus the JASON studies and Technical Intelligence in areas critical to national security. JASON 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.

FY 2006 Plans:

(U) Continue to focus the JASON studies and Technical Intelligence in areas critical to national security. JASON 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.

FY 2007 Plans:

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