Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Office of the Secretary Of Defense	**Date:** May 2017
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
Total Program Element	49.409	53.517	48.269	49.748	-	49.748	55.971	56.495	57.312	58.517	Continuing	Continuing
P534: *Lincoln Laboratory*	40.135	44.886	39.576	44.275	-	44.275	49.254	49.717	50.436	51.494	Continuing	Continuing
P535: *Technical Intelligence*	9.274	8.631	8.693	5.473	-	5.473	6.717	6.778	6.876	7.023	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Lincoln Laboratory (LL) research 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 Program supports innovative, multi-disciplined research that addresses critical national security problems. The LL Program funds innovations that directly lead to the development of new system concepts, technologies, components and materials in support of DoD missions. Funding is applied to support high-risk, high-payoff research that provides unique and specialized capabilities to the current and emerging needs of the DoD. The LL P534 Program funds ten technology project areas. Of these, there are five core-technology areas:

- Advanced Devices
- Optical Systems and Technology
- Information, Computation and Exploitation
- Radio-Frequency (RF) Systems and Technology
- Cyber Security

In addition, there are four emerging-technology initiatives:

- Novel and Engineered Materials
- Quantum System Sciences
- Biomedical Sciences and Technology
- Autonomous Systems

In FY 2017, an Integrated Systems initiative has been added. This area focuses on combining novel technologies from Lincoln Laboratory's research and development efforts (as well as from commercial and academic R&D) with Lincoln Laboratory's system architecture and system engineering expertise to create breakthrough system-level designs and prototypes.

The ten technology areas provide critical capabilities that support all the Department of Defense (DoD) mission areas pursued at the Laboratory. In general, the categories are selected in consultation with ASD(R&E) and with guidance from other DoD agencies to address technology as well as system needs. The new initiatives are chosen to address difficult emerging problems as well as longstanding problems to which new technology advances can be applied. The individual projects in each area are selected with a goal of enhancing DoD capabilities significantly, rather than incrementally.

Supporting these and other priority technology and capability areas are work efforts entitled Technical Intelligence:

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- The Technical Intelligence Program provides global science and technology (S&T) awareness and context in order to assist Defense decision-makers plan for an uncertain future. The program uses intelligence-based and open-source information to characterize today's global S&T environment, exploiting novel technology watch and horizon scanning (TW/HS) tools to identify nascent and disruptive technologies that will shape tomorrow's future. The program complements this with tailored technical assessments that identify the military relevance, research opportunities, and policy recommendations for emerging and disruptive technologies.

B. Program Change Summary ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**
Previous President's Budget	50.925	48.269	49.793	-	49.793
Current President's Budget	53.517	48.269	49.748	-	49.748
Total Adjustments	2.592	0.000	-0.045	-	-0.045
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	4.300	-			
• SBIR/STTR Transfer	-1.708	-			
• Other Adjustments	-	-	-0.045	-	-0.045

Change Summary Explanation

In FY 2016, $4.3 million was reprogrammed into the X-Lab project to support Missile Defeat initiatives.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Office of the Secretary Of Defense		Date: May 2017
Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*	**Project (Number/Name)** P534 / *Lincoln Laboratory*

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
P534: *Lincoln Laboratory*	40.135	44.886	39.576	44.275	-	44.275	49.254	49.717	50.436	51.494	Continuing	Continuing

A. Mission Description and Budget Item Justification

The ten Lincoln Laboratory research areas that comprise the overall LL P534 research and development portfolio are described below:

Five core-technology areas:
• Advanced Devices emphasizes the development of devices and subsystems utilizing microelectronic, photonic, biological, and chemical technologies to enable new approaches to Department of Defense (DoD) systems. Projects include technologies for high power radio-frequency (RF) devices; multi-function, highly integrated lasers; fast and sensitive imagers; and mechanical microsystems for autonomous systems.
• Optical Systems and Technology focuses on developing optical technologies for visible, infrared, and wide band spectroscopic sensing as well as communications systems. The projects areas include high energy lasers; scalable focal plane imaging technology; photonic integrated circuits; optical system prototypes; and associated phenomenology measurements.
• Information, Computation and Exploitation develops novel architectures, tools, and techniques for the processing, fusion, interpretation, computation, and exploitation of multi-sensor, multi-intelligence data. Projects include innovative hardware and software technologies for graph processors and cloud computing; artificial intelligence and graph algorithms for analytics, including deep learning algorithms; multi-intelligence analytics, including open-source data processing techniques; and human-machine interfacing and automation technologies to enhance warfighter effectiveness and ability to work with advanced computing systems.
• Radio-Frequency (RF) Systems and Technology focuses on RF technologies to enhance warfighting capabilities in radars, electronic warfare (EW), and communications. Projects include development of next generation phased arrays; ultra-wideband RF systems; compact RF systems; small satellite RF payload; and advanced algorithms for jammer mitigation and EW.
• Cyber Security focuses on the development of technologies and new techniques for the protection of systems against cyber-attack and exploitation. Projects include research into technologies for cyber situational awareness, command and control; technology to improve resilience of systems to cyber-attack; and technologies for system exploitation research. A new area focusing on cyber-EW systems is being planned for future work.

Four emerging-technology initiatives:
• Novel and Engineered Materials emphasizes research in new materials for additive manufacturing and emerging nanoscale materials. Projects include research in RF materials for 3D printing; other advanced 3D printing technologies; revolutionary semiconductor materials; and microsystems using metamaterials.
• Quantum System Sciences focuses on the development of quantum-based technologies that support sensing, communication, computation, and algorithms using quantum information. The projects include the demonstration of scalable computation platforms, demonstration of quantum protected communications and magnetic field sensing using highly-compact, atomic-like defects in diamond, prototyping revolutionary quantum networking systems and technology, and research into advanced quantum algorithms.
• Biomedical Sciences and Technology supports the development of bio-engineered and biomedical technologies to aid the warfighter. Projects include brain imaging technologies; relevant research in brain and cognitive sciences; engineered biological systems to aid physiology understanding; and technologies to assess physical performance and enhance injury recovery.

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• Autonomous Systems has the objective of developing mobile, autonomous, robotic platforms, as well as sensors and algorithms that support key capabilities needed for a wide range of DoD applications. Projects span advanced artificial intelligence and processing; sensors and communications for unmanned platforms; platform designs and energy systems; human-machine interactions; and verification and validation of autonomous systems.

One system technology initiative:
• Integrated Systems uses multiple new technologies to solve an important national need. Systems selected for funding have an applied research component related to the integration process. Projects target key DoD warfare domains, including space, air, land, sea surface, and undersea. This is a new area in FY 2017, and currently projects addressing the space (3D Ladar for small satellites), land (cloud-assisted tactical computing), and undersea (maritime laser-communications) are underway. There are plans to initiate projects for the air (autonomous micro-air vehicles) and sea (unmanned surface vehicles) domains in FY 2018 and FY 2019.

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018**
Title: Advanced Devices	5.482	4.744	5.291
Description: This project area targets the research and development of unique and innovative components, subsystems, and sensing concepts or methodologies that will enable new solutions to important Department of Defense (DoD) problems. Activities under this technology area include specialized silicon and compound semiconductor-based devices for radio-frequency (RF), analog, mixed-signal, and digital electronics; photonics, optoelectronics and laser technologies; and novel devices and concepts for chemical, biological, and radiation sensing. ***FY 2016 Accomplishments:*** In FY 2016, five projects were continued from FY 2015 and three projects were new starts. The continuing digital charge-coupled device (CCD) imager project constructed and demonstrated two cameras that incorporated the new imager technology fabricated in the Lincoln Laboratory Microelectronics Laboratory (ML). One of the cameras included a novel low-noise readout circuit and the other camera incorporated the hybrid integration of a CCD and analog-to-digital converters (ADCs) to enable kilohertz readout rates. Development also continued on germanium (Ge) CCD imagers that can offer broadband visible and short-wave infrared imaging, as well as sensitivity for higher-energy x-rays relative to silicon-based detectors. In FY 2016, the germanium CCD fabrication process was transferred to the 200-mm toolset available in the ML and prototype imagers were designed and fabricated. A new advanced-imager project involved the development of pixel-to-pixel crosstalk reduction techniques for compound-semiconductor Geiger-mode avalanche photodiode (GmAPD) arrays. These techniques enable the reduction of the pixel pitch to enable GmAPD arrays having larger formats. Work continued on the development of a low size, weight and power (SWaP) optical communications transceiver incorporating silicon photonic integrated circuits (PICs). During the past year, silicon PICs were characterized and second-generation PICs were designed. A new integrated-photonics project involved the development of high-power, broadband optical sources for interferometric fiber-optic gyroscopes (IFOGs). Both the spectral bandwidth and the electrical-to-optical conversion efficiency of these optical sources were improved. Work continued on the development of designs and models to increase the efficiency of quantum-cascade lasers (QCLs) operating in the 9-μm-wavelength region for infrared countermeasures. In the area of advanced electronics, work continued on the development of high-power, microwave diamond transistors for radar, electronic-warfare, and communications applications. The current density of			

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Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*	**Project (Number/Name)** P534 / *Lincoln Laboratory*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018**
diamond p-MOSFETs was increased 100X by applying a NO2 surface treatment and a growth reactor was installed to enable the in-house growth of diamond materials to accelerate progress on this project. The microhydraulic actuator project was refocused to realize configurations that emulate human muscle and single-layer demonstrations were performed. ***FY 2017 Plans:*** For FY 2017, Advanced Devices has eight projects: (1) Digital CCD is a continuing effort that is combining the best attributes of CCD and CMOS-based imaging devices, including a massively parallel analog-to-digital converter architecture with scientific-grade CCD pixels and amplifier designs with sub-electron noise; (2) Diamond Power Transistors is a continuing effort that is developing high-performance power transistors for radar, electronic warfare, and communication applications; (3) Germanium CCDs is a continuing program to develop germanium-based CCDs for large-format, high-quality short-wave IR imaging; (4) Zero-Crosstalk IR Geiger-mode Avalanche Photodiodes (GmAPDs) for Multi-mode Imagers is a continuing project that focuses on the elimination of crosstalk between pixels in InGaAs-based GmAPD arrays to enable dramatically reduced spacing between pixels; (5) Photonic Integrated Navigation-Grade Gyroscope (PING) is a continuing effort that is developing environmentally stable optical sources to improve the long-term stability of interferometric fiber-optic gyroscopes (IFOGs); (6) Flexible Microhydraulically Actuated Fibers is a continuing effort that is developing of a liquid-solid scalable actuator that mimics biological muscle; (7) Scalable Silicon Geiger-mode APD Arrays is a new effort that is developing novel crosstalk reduction techniques for silicon-based GmAPDs for lidar and passive-imaging applications; (8) Multifunction Undersea Blue-Green Laser Transmitter is a new project that is developing gallium-nitride (GaN) based materials and photonic components (e.g., lasers, optical modulators) for high-power transmitters for underwater optical communications. ***FY 2018 Plans:*** More sensitive, larger format imagers integrated with small-pitch read-out integrated circuits (ROICs) will become available. Subsystem demonstrations of photonic-integrated gyroscopes will measure the gyroscope accuracy and reliability. Prototype of high-power, wideband circuits based on diamond transistors will help evaluate the promise of this technology. GaN-based photonic components operating at blue-green wavelengths will be matured and demonstrated in system prototypes. For the most advanced devices, diamond electronics will focus on realizing radio-frequency metal-oxide having current-gain—bandwidth product of 50 GHz.			
Title: Optical Systems and Technologies ***Description:*** This project-area conducts research through the development, analysis, and demonstration of novel concepts, technology, and systems for the next-generation of optical systems for the DoD. The primary goal of this project area is to invest in optical-based technologies that fill the critical technology gaps in emerging DoD threat areas, such as anti-access/area denial (A2/AD), counter–weapons of mass destruction (C-WMD), and asymmetric warfare, as well as to develop revolutionary optical technologies in the traditional DoD mission areas such as intelligence, surveillance, and reconnaissance (ISR), space control, communications, and ballistic missile defense.	6.100	4.877	5.440

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Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*	**Project (Number/Name)** P534 / *Lincoln Laboratory*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
FY 2016 Accomplishments: In FY 2016, Optical Systems and Technology entailed a total of twelve projects, including computational imaging, LADAR technologies, free-space communication technologies and space surveillance capabilities. The portfolio included novel optical technology developments applicable across a broad range of DoD problems. A Digital Coherent Aperture Combiner was developed that performs adaptive optics in the digital domain to synthesize a much larger aperture receiver to reduce the size and cost of communication ground terminals while improving resistance to signal fading. A Deployable In-Space Coherent Imaging Telescope (DISCIT) was designed with the ability to “unfold” a large optical aperture from a small satellite in order to provide transformational advantages to the DoD. This telescope has the goal of demonstrating a 70 cm telescope with single-fold composite hinges and using target in the loop image compensation to achieve image quality comparable to a full-aperture telescope, as well as addressing multiple hinge technology for scaling to larger (multiple meters) apertures. A novel Micro LADAR system for the use on hand-launched unmanned air vehicle was designed, supporting subsystems were developed, and a prototype system was demonstrated on a testbench. An Undersea Optical Communication testbed was developed that successfully demonstrated high data rate optical communication techniques under water. After four years of funding, the Long-Baseline Interferometer testbed completed its final year by successfully designing, fabricating and integrating a novel spectrometer in order to improve the state-of-the-art in sensitivity and image quality by nearly and order of magnitude. A photo-thermal speckle detection technology was developed that can identify chemicals present in trace amounts at small stand-off distances. Such capability is important in the modern battlefield and for protecting crowd in various venues. The Panelized Laser Transceiver effort started mid-year FY 2016 to develop a new architecture for a scalable phased array laser transmitter and receiver. ***FY 2017 Plans:*** In FY 2017, Optical Systems and Technology is continuing to fund four previous-year projects in order to bring their efforts to successful demonstrations: DISCIT, MicroLADAR, Digital Coherent Aperture Combiner, and Panelized Laser Transceiver. In FY 2017, five new projects have been initiated: (1) the Zero-Seam-Loss Large Format Tiled IR DFPA project, which shows great promise to scale focal plane sizes for many different imaging detectors by orders of magnitude; (2) the Long-wave Infrared (LWIR) Coherent Laser Radar project, bringing to remote sensing methodologies orders of magnitude increase in sensitivity in tactically useful wavebands; (3) the Computational Reconfigurable Imaging Spectrometer project to extend the SEEIT methodology to hyperspectral imaging; (4) the On Orbit Sensor Test and UV Phenomenology for Space Situational Awareness Systems project, that is leveraging a Lincoln developed UV space sensor for an experiment on the International Space Station; and finally (5) an Integrated Planar-Lens Based Chip-Scale Lidar project that takes optical LADAR into the extremely small form factor, integrated photonics domain. ***FY 2018 Plans:*** Optical Systems and Technology will continue to develop advanced technologies in lasers and receivers as well as in novel optical systems and architectures for next-generation capabilities for national security challenges. An ultraviolet spectral band sensor			

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
being built in FY 2017 will launch on the International Space Station to sense the local space environment. This experiment will provide new insights into the near-earth space environment. Demonstration of the small laser radar will reveal limits to real-time three-dimensional images obtainable from a small platform. Design will commence on integration into an unmanned air vehicle. A number of military applications are expected to spin out of the digital coherent aperture combining, the deployable optics in space, and large Geiger-mode APDs.			
Title: Radio Frequency (RF) Systems and Technologies ***Description:*** This project area focuses on research, development, and evaluation of innovative RF technologies and concepts in anticipation of Department of Defense (DoD) and intelligence community requirements for radar, signals intelligence (SIGINT), communications, and electronic-warfare (EW) applications. Key RF challenges being addressed include a rapidly expanding threat spectrum, platforms with severely constrained payloads, operations in strong clutter and interference environments, detection of difficult targets, and robustness against sophisticated electronic attack. RF technologies of interest include antennas, filters, transmit/receive modules (high-power amplifier, low-noise amplifier, phase shifter, time domain up-sampling), beamformers (analog, digital, photonic), receivers/exciters (local oscillator, mixers, filters, analog-to-digital converter, digital-to-analog converter), and novel RF packaging concepts. RF systems concepts that address novel analog/digital/photonic architectures and signal processing techniques for improved RF performance are also being pursued. ***FY 2016 Accomplishments:*** In FY 2016, key accomplishments included; (1) the demonstration of an aperture-level simultaneous transmit and receive (STAR) array with over 100dB of coupling isolation on the Aperture-Level STAR (ALSTAR) project; (2) the demonstration of integrated Si-based micro-jet cooling for high power density arrays on the Embedded Micro-jets project; (3) the design of an ultra-light, deployable space-based radar phased array panel with a mass density of 5 kg/m^2. This project built a mechanism for satellite deployment with one-micron reproducibility, which enables the deployment of a 20m x 1m array; (4) the demonstration of a high output power GaN on Si HEMT transistors with high transition frequency as part of the GaN on Si CMOS project; (5) The system design and analysis of Multiple-beam Directional Networking system concept was completed and summarized in a detailed technical report; (6) The array based compressed sensing receiver (ACRA) prototype was completed and tested, with demonstrated results showing significant benefits of a wideband ESM system in a sparse spectrum environment. This work is expected to have a major impact on electronic warfare capabilities; and finally, (7) The Out-Phased Array Linearized Signaling (OPALS) project completed testing using emulated channels; the successes in this project have led to a patent filing. ***FY 2017 Plans:*** In FY 2017, a number of projects are continuing in the areas of advanced RF electronics, including Aperture Level Simultaneous Transmit and Receive (STAR) for Phased Array Applications, Gallium Nitride (GaN) on Silicon for Next-Generation Phased Arrays, Embedded Microjets for high thermal power density cooling, and Lightweight Deployable Antenna arrays for small-satellite applications. Two new projects were started in FY 2017, including (1) the Jammer Mitigation and Jammer System Development project, which is developing uninterrupted wireless communication in realistic jammer environments enabled by	5.020	3.761	4.195

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Receiver processing mitigation (RPM) algorithms that require no additional antennas and no changes in the waveform; and (2) the Wideband RF Advanced Spectral Processor (WRASP) effort, which is developing new architectures for ultra-wideband receivers with high dynamic range and on-chip spectral power detection, digital cueing, and signal processing to minimize off-chip data transfer. ***FY 2018 Plans:*** RF Systems and Technology will continue to focus research on advanced RF technologies in support of emerging needs for radar, SIGINT, communications, and EW systems. Some of the newer efforts that require fabrication of components, such as the GaN-on-Silicon for Next-Generation Phased Arrays projects, will likely require significant multiyear investments to be at an appropriate stage of development for transition. Other projects that utilize mostly commercial components in novel architectures or that have already been supported for multiple years will seek nearer-term transition opportunities. The selection and evolution of efforts will support the wide range of Laboratory mission areas that rely on new RF technology components and systems.			
Title: Information, Computation, and Exploitation Sciences ***Description:*** This project area is intended to achieve significant technical gains in data processing, computation, exploitation, and information visualization for DoD applications. The volume, velocity, and variety of information production and consumption are growing at exponential rates, requiring the development of innovative ways to deal with this "big data" deluge. Projects focus on novel computing architectures, hardware, analytical techniques, and tools for high throughput processing, fusion, interpretation, and exploitation of "big data", especially for multi-sensor, multi-intelligence data. ***FY 2016 Accomplishments:*** ICE had several major accomplishments in FY 2016: (1) The initial Graph Processor prototype system composed of commercially developed FPGA boards achieved performance exceeding that of commercial supercomputers for the sparse matrix-matrix multiply function, which is the most processing-intense computational kernel associated with graph-based analytics; (2) The Lincoln Laboratory Supercomputer Center (LLSC) achieved world-record performance for ingesting "big data", which is critical for the emerging DoD Internet of Things (IoT) architecture, across SQL, NoSQL, and NewSQL databases; (3) The highly integrated low-power embedded analytics processor demonstrated 3-10x performance gains compared to conventional systems for several important "big data" techniques; (4) Algorithmic techniques to address low-truth databases, which are typical for DoD applications, were developed and refined. In particular, the Dynamic Deep Learning (DDL) project developed an approach that optimizes the required neural network architecture in such low-truth environments while achieving near-human-level classification performance on surveillance video data; (5) The architecture for Computer-on-Watch project, an autonomous Processing, Exploitation, and Dissemination (PED) system focused on Indicator & Warning (I&W) applications, was defined and initial machine learning algorithms for target recognition were developed that use transfer learning techniques to improve performance; (6) Additional data sources were added to the collaborative Open Source Data Initiative (OSDI) infrastructure framework for researchers exploring large data sets obtained from multiple data source types and formats; (7) Work was completed on the development of formal	4.606	5.189	5.788

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
bounds for detection of anomalies in complex networks and on the use of information theoretic approaches to better assess team decision making in a multiple source, rapidly changing Big Data environment. ***FY 2017 Plans:*** The Graph Processor effort is completing its three-year development by executing multiple real-time graph analytics functions on a 64-node field-programmable gate array (FPGA) integrated into the Lincoln Laboratory Supercomputer Center (LLSC). Data sets of interest to the Department of Defense (DoD) and Intelligence Community are being benchmarked. Concepts for lower power application-specific integrated circuit (ASIC) systems are also being developed.The Massive Computation and Resiliency Internet of Things (IoT) project is exploring the use of advanced commercial compute devices to perform relevant mathematical and data storage/access functions at high performance-to-power ratios as well as efficient approaches for secure multi-party computation on Big Data data-sets. Other efforts continue to focus on novel machine learning techniques. The Dynamic Deep Learning (DDL) project is refining architectural optimization approaches while addressing its implementation on constrained low-power embedded systems. The Computer-on-Watch project is focusing on early warnings applications based on adaptive deep learning algorithms. The new Adaptable, Interpretable Machine (AIM) learning project is providing analysts and decision makers with explanation and provenance of results obtained by machine learning techniques. This project is also developing new technologies to enhance system performance over time through user-feedback machine-learning techniques. The Open-source Data Initiative project continues to be upgraded to provide the needed foundation for future algorithm developments. ***FY 2018 Plans:*** The Internet of Things (IoT) project will prototype secure cloud computing techniques for protecting military systems deployed in networked architectures. Advanced machine learning techniques will continue to be developed through Dynamic Deep Learning (DDL), Computer on Watch, Adaptable, Interpretable Machine (AIM), and open-source intelligence projects. Machine learning efforts will expand to national security environments where tagged training data are sparse. These techniques will help the war-fighter make better decisions based on current knowledge. New real-time processing approaches such as the graph processor effort will reduce size, weight, and power to allow advanced analytics to be deployed to the tactical edge. Transition of the graph processor technology to operational use will be pursued. In addition to approaches for larger data-center applications, the portfolio will address high-performance computing architectures for size, weight, and-power–efficient data exploitation and cognitive decision support systems located at the tactical edge, including small UAVs and local ground stations.			
Title: Cyber Security ***Description:*** This area conducts research, development, evaluation, and deployment of prototype components and systems designed to improve the security of computer networks, hosts, and applications, thereby assuring the resilience of Department of Defense (DoD) missions against cyber-attack and exploitation. A particular focus is the overlap between the DoD mission areas and the cyber domain. Efforts include cyber analysis; creation and demonstration of robust architectures that can operate through cyber-attacks; development of prototypes that demonstrate the practicality and value of new techniques for cryptography, cyber sensing, automated threat analysis and course of action selection, anti-tamper systems, and malicious code detection;	5.113	3.879	4.326

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Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*	**Project (Number/Name)** P534 / *Lincoln Laboratory*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
demonstrations of the impact of cyber on traditional kinetic systems; quantitative, repeatable evaluation of these prototypes; and, where appropriate, deployment of prototype technology to national-level exercises and DoD and intelligence community operations. ***FY 2016 Accomplishments:*** In FY 2016, the Cyber Security project area had accomplishment in a number of key areas: (1) Reverse-engineering tools were further developed to permit deep analysis of data flow through software applications and were tested for widespread use by the community. These tools permit analysis of software running on a variety of different processor architectures (e.g., x86, ARM and PowerPC); (2) A related project leveraged this capability to create software vulnerabilities on-demand in support of research in discovery and remediation; (3) A prototype, net-centric, enterprise-wide cyber situational awareness platform was designed and developed. On this platform, advanced graph analytics, contextual search, and georeferenced visualization techniques were demonstrated on Lincoln Laboratory operational data. Elements from this prototype were used operationally to defend the Laboratory's networks and were deployed at several regional combatant commands; (4) Multiparty computation research resulted in a significant speed-up through the use of sparse matrix representations, fixed point arithmetic, and new analysis techniques for data provenance;(5) An enhanced private cloud testbed demonstrated new secure operation capabilities for use on DoD systems; (6) Tests on a real-time flight simulator application demonstrated secure computing by decrypting a minimum amount of data and operating instructions. Finally, (7) a project prototyped insertion of hardware vulnerabilities in chip-level system components, to aid in the development of detection techniques. ***FY 2017 Plans:*** Cyber Security projects in FY 2017 continue research into developing a broad range of tools in hardware and software to help discover new threats, add robustness to current architectures, and understand ways to improve this development cycle. Work is on-going to develop hardware that emulates cyber threats to the supply chain. These emulated threats support DoD cyber testing and training activities. Research into software that enhances security robustness include the development of efficient protocols to permit computation on encrypted data stored in a public cloud, and the development of architectures, applications and tools to permit secure and resilient cloud computing, along with development of a testbed to assess the level of security achieved. Efforts to better understand vulnerabilities also form another significant branch of the FY 2016 research goals. The current development of metrics and methodologies for evaluating software security by analyzing the exploitability of software vulnerabilities and their exposure to attackers is complemented by the effort to automatically create subtle vulnerabilities within pieces of test software, supporting researchers who seek to build and evaluate software vulnerability detection systems. Several new efforts have been launched which focus on emerging areas of interest, including cyber decision automation using modeling and simulation, exploring the security implications of the Internet of Things in order to create cyber security design guidelines and recommendations for future small satellites, and developing effective indicators for insider threat behavior by analyzing sponsor-provided data. ***FY 2018 Plans:***			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Rapid response to the evolving cyber threats and new technology trends on the horizon along with Lincoln Laboratory's DoD cyber expertise will continue to guide future plans in Cyber Security. New research will be initiated that use and extend proven interaction models to evaluate network segmentation strategies that provide maximal advantage to defenders. The focus on developing secure systems that may be composed from foreign manufactured components will continue, particularly those which are part of the Internet of Things. Big Data analytics in support of cyber situational understanding and effective, timely decision making will play a key role in future applied research. Finally, strategies to mitigate adversary ability to limit US cyber/ electronic warfare (EW) capabilities will continue to be developed and tested.			
Title: Biomedical Sciences and Technology ***Description:*** This project area focuses on developing expertise and technologies to advance research and development in the biosciences, with the goals of developing technologies (1) to enhance warfighter health and performance and (2) to prevent or predict injury through individualized biological monitoring, analysis, and interventions. Collaborative relationships with local academic and medical institutions are enabling Lincoln Laboratory to make significant contributions in areas that aid warfighter health and well-being, and leverage emerging research trends, such as quantum sensors. ***FY 2016 Accomplishments:*** There were several accomplishments in Biomedical Sciences and Technology in FY 2016, including: (1) The Non-Contact Ultrasound System for Volumetric Imaging project (NCLUS) successfully adapted hardware to enable (a) 3D imaging around a residual limb and (b) location of small metal pieces, such as shrapnel, within tissue; (2) The Artificial Gut (ArtGut) project developed both an ArtGut prototype to enable rapid microbiome experiments as well as a microfluidic device that can characterize complex microbial samples. (3) In collaboration with United States Army Institute of Surgical Research (USAISR) and the Broad Institute of MIT and Harvard, a new effort started to identify molecular-level functions associated with muscle recovery/repair after volumetric muscle loss. The goal is to direct healing tissue along the correct trajectory. Among the many accomplishments, the first mapping of the messenger RNA molecules involved in muscle loss was built; (4) A complementary effort, the 3D multi-material Bio printer project, made progress addressing gaps in current technologies to enable printing of complex biological materials such as cartilage; (5) The Functional Brain Network Analysis project collected data on neural connectivity by collecting electroencephalogram (EEG) and eye-tracking data simultaneously during task learning. Initial results were analyzed to identify key features associated with a high performing neural state; (6) The Microelectronics Interfacing Neural Devices (MIND) project designed the world's smallest (0.2 mm x 0.1 mm), single-channel, fully-wireless neural sensor. Fabrication of this device was begun (and is being completed in FY2017); (7) A cellular-resolution brain-mapping project was begun that utilizes data gathered from a novel micro-scale brain mapping method (CLARITY) to build a big-data management framework for brain imagery. This enables the development of automated neuron-tracing algorithms and initial prototypes of these algorithms were completed. Finally, (8) the neuroscience algorithms projects also developed the first neuro-biophysical vocal track model to assist in determining the biological basis of vocal changes associated with changes in neurocognitive status; this project involved a collaboration with United States Army Research Institute of Environmental Medicine (USARIEM) to collect experimental data and	3.320	4.373	4.812

Exhibit R-2A, RDT&E Project Justification: FY 2018 Office of the Secretary Of Defense		Date: May 2017
Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*	**Project (Number/Name)** P534 / *Lincoln Laboratory*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
begin the development of a model of how the brain handles competing demands for cognitive resources such as walking, talking, and memory. ***FY 2017 Plans:*** In FY 2017, ongoing projects include: (1) The ArtGut program is completing a functional ArtGut prototype system for use at Lincoln that can be transitioned to collaborators for future projects. The project is developing a demonstration of in-vitro sustained cultures of defined microbial communities. The project FY 2017 goals are to compare the metabolic activity of these microbial communities to more traditional benchtop culture results as well as to model predictions; (2) The NCLUS effort is completing development of full 3D imaging capability to support the fabrication of prosthetics for amputees; (3) A related project is focusing on automated bio image analysis; (4) The volumetric-muscle-loss project is culminating this year with in vitro demonstrations of directed cell differentiation to restore muscle function; (5) The MIND project is fabricating a neural sensor so small it can be inserted into the brain without damaging neurons; (6) Ultra-sensitive magnetic field measurement technology from the Quantum System Sciences project area is being used to build a better magnetoencephalograph for brain imaging; (7) The brain-mapping project is developing improved algorithms for neuron-tracing, leveraging software algorithms used in ballistic missile defense and other image-tracking applications. Finally (8) the neurocognitive project is modeling sensorimotor control to better understand experiments conducted in the newly-opened immersive virtual reality dome at Lincoln Laboratory. ***FY 2018 Plans:*** Biomedical Sciences and Technology will see increasing emphasis on multimodal data collection and analysis in diverse application areas (e.g. cognitive and neuroscience, microbiome-related, tissue healing), in keeping with emergent science trends and anticipated DoD needs. Many of these efforts will augment the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) initiative being led by DARPA and the NIH. The increased understanding will also aid in treatment of soldiers with traumatic brain and other battlefield injuries. This project area will continue to develop concepts and technologies in medical sensing, imaging, and diagnostics, cognitive analytics, and cellular and molecular engineering. Multimodal approaches to understanding physiological and psychological status will continue. Novel tool and platform development focused on accelerating and improving biotechnology research will also continue. Medical image processing and rehabilitation tools will be explored by leveraging existing Laboratory expertise in image processing, signal analysis, and decision support algorithms.			
Title: Autonomous Systems ***Description:*** This project area performs applied research in autonomous robotics to address current and anticipated DOD mission needs. A principal goal is to enable unmanned systems to perform useful tasks in uncertain environments as trusted, capable agents without continuous human operator control. Projects span the development of a full range of autonomy algorithms and technologies. Technology areas include perception and world modeling, planning, human-robot interaction, manipulation, learning and adaptation, and robotic platforms. ***FY 2016 Accomplishments:***	3.377	3.501	3.904

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Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*	**Project (Number/Name)** P534 / *Lincoln Laboratory*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018**
In FY 2016, this project area had several accomplishments, including: (1) A multi-function digital vision sensor was prototyped for real-time, autonomous, low-altitude optical navigation. Algorithms that use limited on-sensor computation and are rapid enough for real-time feedback were implemented. A closed loop simulation of high-speed obstacle avoidance with an emulated sensor was demonstrated. The sensor is now being integrated with a micro-camera; (2) Another effort developed, implemented, and tested algorithms for data-driven UAV path planning. This research used an open-source robotics library and a custom node to communicate with a serious gaming engine, which is also used by the Army; (3) Software libraries to enable intelligent path planning in DRAKE (a collection of tools for analyzing the dynamics of our robots and building control systems for them in MATLAB and C++) were implemented and tested by manipulating dynamic known objects on an industrial robot arm; (4) Interception of at-speed surface ships using newly developed autonomy software performed well in at-sea testing, which validated both the software and the ocean flow models. As an outgrowth, dolphin bio sonar techniques and strategies were investigated for use on an Unmanned Underwater Vehicle (UUV) platform for mine clearing of bottom and buried mines. This effort completed the real-time autonomous mission simulator tools for biomimetic sonar area search and made progress on the field test setup. The mission simulator was used to establish performance metrics for area clearance; (5) A project that used a multi-stage linear ionization array for silent airborne propulsion was initiated, and progress was made on aerodynamic modeling and propulsion system prototyping. Control of a high-efficiency glider air-frame was designed, fabricated, and flight tested. Optical imaging of gases to measure acoustic pressure visualized the ionic wind and informed the thruster design; (6) A new research project was begun that developed algorithms for decentralized coordination for teams of autonomous systems started. Advanced methods to improve performance for large observation spaces were developed and new techniques to account for adversarial opposition were created. ***FY 2017 Plans:*** Autonomous System projects are continuing in the hardware and algorithm development areas and are expanding to include key efforts to address autonomy in the face of uncertainty. A demonstration is being developed for a digital vision sensor for fast autonomous airborne navigation in a dynamic flight test. Coordination algorithms for multi-agent Unmanned Air Vehicles (UAVs) using decentralized planning algorithms are being developed and tested with real-world communication constraints. Development of size, weight and power (SWaP) constrained adaptive communication algorithms is continuing, with the goal of enabling large-scale multi-robot teams. A biomimetic sonar project is developing autonomous object detection, localization and classification. Simulations, experimental studies of ionized flow field and aerodynamic interactions, and field testing are taking place to improve silent UAV performance. Work to exploit common structures to describe environments with reduced parameter sets and optimize perception algorithms for low computation sparse sensing and explore the separation of sensing and computation to enable truly autonomous micro UAVs has begin. Development and extension of Petablox, which is a specification language that enables users to specify autonomous systems properties, for use in verification of tightly integrated autonomous systems has begin, and is being combined and compared with newly enhanced DRAKE verification algorithms utilizing complex dexterous manipulation testing. ***FY 2018 Plans:***			

Exhibit R-2A, **RDT&E Project Justification:** FY 2018 Office of the Secretary Of Defense		**Date:** May 2017
Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*	**Project (Number/Name)** P534 / *Lincoln Laboratory*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018**
Continuing the focus of teaming in complex environments, research will continue to improve current autonomous system capabilities for air, land, sea and cross-domain problem sets with the overall goal to develop more advanced autonomy, in-situ adaptation, and learning in unstable, complex environments to reduce risk to war-fighters. These improvements will encompass both hardware advancements, such as the on-going silent propulsion system, as well as algorithm improvements for swarm and multi-agent coordination, and verification and validation of complex autonomy that interacts with humans and the physical world.			
Title: Quantum System Sciences ***Description:*** This project are is developing methods for sensing, communicating, and processing information using quantum mechanical systems that manipulate information in ways that are not possible in classical systems. A number of different physical quantum systems and applications are being pursued with a focus on approaches that can be scaled to address national security challenges. A major goal of this project area is to establish a robust scientific foundation upon which future application-oriented and large-scale development programs will thrive. ***FY 2016 Accomplishments:*** During FY 2016, the work in this project area was divided among quantum computing, including experimental efforts, simulations, algorithm projects, quantum communication, and quantum sensing. In the quantum computing area, Lincoln Laboratory made significant improvements in integrated electronics for trapped ions, co-trapping Calcium and Strontium ions for the first time, which is critical to scalable approaches to ion manipulation and measurement. Advances were also made in three-dimensional integration of superconducting qubits and the design of a chip with five coupled qubits. These experimental efforts were supplemented with advances in simulation of correlated noise/errors to understand its impact on quantum error correction and advances in algorithms for loading large, sparse matrix data into qubits to enable an exponential speedup for an important class of linear algebra algorithms. The FY 2016 quantum communication work included the characterization of a high-rate source and receiver of continuous-variable quantum optical states operating in the ultra-high-bandwidth, low brightness regime. The quantum communication project modified a high-speed secure communication protocol capable of achieving greater than 1-Gbps secure rates over 40-km fiber spans. This represents a 1000x increase in rate over current state-of-the-art quantum key distribution systems. Finally, improvements in the dynamic range and vector measurement capabilities were demonstrated for magnetic sensors based on nitrogen-vacancy atomic defects in diamond. ***FY 2017 Plans:*** Multi-qubit operations are being explored in both the trapped ion system, using the two ion species, and in the superconducting qubit system, using the recently fabricated chips and a new approach to 3D integration for enabling qubit coupling in a scalable array format. The work on simulation tools is being expanded, particularly in support of simulating the trapped ions, and the feasibility of implementing the quantum computing algorithm for exponential speedup of linear algebra is being evaluated in terms of the number of gates for problem sizes that cannot be addressed by classical supercomputing. The quantum communication entanglement distribution effort is being expanded to a three-node multi-span architecture that includes an investigation into photonic qubit quantum memory architectures based on defect-centers and ion traps. The sensitivity of the magnetometer using	4.772	4.537	5.060

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Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*	**Project (Number/Name)** P534 / *Lincoln Laboratory*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
nitrogen-vacancy defect states in diamond is being further improved by using more optimized diamond samples and advanced pulse sequences. ***FY 2018 Plans:*** Quantum communications will target the development of quantum network system architectures and technologies capable of supporting short-haul quantum computing integration and long-haul quantum state transmission over long distances. Advances in trapped ion and superconducting qubits will continue to be aimed at integrating the control and measurement in a third dimension to enable the development of larger arrays for exploring noise correlations and proper error correction techniques. Also, in addition to continued advances in superconducting qubits, trapped ions, quantum networks and quantum magnetometry, additional efforts will be made to advance techniques for mitigating noise. Finally, more emphasis will be placed on approaches to couple together these modalities, such as quantum state transfer between a trapped ion and photon and leveraging the ions for quantum sensing and quantum clocks.			
Title: Novel and Engineered Materials ***Description:*** This project area develops materials and processes that make a transformative impact on enduring national challenges. Areas of strategic focus are material property customization and material enablers for ultra-low- size weight and power (SWaP) systems. ***FY 2016 Accomplishments:*** Important advances were made in the additive manufacturing of both structural and functional materials. Compared to natural materials, these novel materials have the capability to offer unique features such as having high strength while also being light weight or having complex responses to radio frequency signals. A particle ejection testbed targeting the fabrication of metal-ceramic microlattices has been completed. Low-loss, two-material, multi-frequency and variable-dielectric devices were also demonstrated as part of a collaboration with Harvard University. A continuing effort investigated the applicability of transition metal dichalcogenide (TMD) materials for flash memory and room-temperature solid-state qubits (logical units of quantum calculation), and achieved first-ever wafer-scale growth of monolayer tungsten disulfide (WS2). Finally, novel multi-material fibers have been demonstrated with controlled emissivity. ***FY 2017 Plans:*** Materials discovery using additive manufacturing continues in FY 2017, and is being expanded with the addition of a new effort to develop electronics-quality printable metal for non-planar substrates. The transition metal dichalcogenide (TMD) project continues to focus on growth of wafer-scale, device-quality materials. The project isdetermining electrical and optical properties relevant to computation. Advanced project work in designing and drawing of composite fibers is focused on developing novel sensing capability in textile form. Additionally, Lincoln Laboratory has launched an expanded effort in phase-change tunable metamaterials to enable ultra-low-SWaP imaging. ***FY 2018 Plans:***	2.796	2.556	3.049

Exhibit R-2A, RDT&E Project Justification: FY 2018 Office of the Secretary Of Defense		Date: May 2017
Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*	**Project (Number/Name)** P534 / *Lincoln Laboratory*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Lincoln Laboratory will continue to leverage additive manufacturing for materials discovery and property customization, and continue to explore novel dimensionalities (1D fibers, monolayer materials) to develop novel structural and functional properties for low-SWaP systems. Optical metamaterials and phase change materials activity will grow in importance, as the need increases for advanced, multifunctional sensing capabilities, such as hyperspectral and polarimetric imaging, super-resolution, and computational imaging in smaller and smaller form factors.			
Title: Integrated Systems ***Description:*** This project uses multiple new technologies to solve an important national need. Systems selected for funding have an applied research component related to the integration process. The goal is to demonstrate DoD-relevant systems that use novel architectures, recently developed component technologies, and new analytic methods. The intent is to support early work on systems that cut across the conventional categories. ***FY 2016 Accomplishments:*** This is a new effort in FY 2017. ***FY 2017 Plans:*** Integrated Systems projects are focusing in three main areas. One effort is developing an integrate Processing, Exploitation, and Dissemination (PED) capability at the tactical edge, by using cloud computing and robust, hierarchical communications technology. This project is designing a Cloud architecture for PED, which would be available at forward-deployed bases. Another project is an Autonomous and Reconfigurable Maritime Networking Demonstration. This project builds on a recent underwater communication demonstration from the Optical Systems and Technology area. In FY 2017, active pointing and tracking of the terminals technology is being for adaptive communications between moving undersea objects. The third effort is focused on risk reduction research and architectural design for a 3D imaging laser radar system to be deployed on a low earth orbit (LEO) satellite. This ladar has the potential to observe structures under foliage with global coverage. ***FY 2018 Plans:*** The FY 2017 Tactical Edge PED effort will do system simulation of a Cloud architecture in a resource-limited environment to disseminate the most valuable information. The underwater communications effort will do in-water testing of a communication network between multiple moving platforms. If risk is reduced enough, the LEO 3D ladar effort will start design and planning for a satellite program. Additional efforts in the micro-air vehicles and and small unmanned surface sea vehicles will be initiated that advance new technologies for autonomous systems capabilities for both of these domains.	0.000	2.159	2.410
Title: Missile Defeat-X Lab ***Description:*** X-LAB in support of Missile Defeat conducts experiments with the goal of demonstrating a multi-INT threat defeat framework using a rapid insertion of new data sources, new analytics and pluggable libraries of analytics and visualization tools	4.300	0.000	-

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Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*	**Project (Number/Name)** P534 / *Lincoln Laboratory*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018**
from developer community (Universities, Industry, Government Labs, FFRDCs). The X-LAB project works towards fusion across unclassified and classified data for the Joint Staff organization and its TCPED demonstrations. ***FY 2016 Accomplishments:*** In FY 2016, X-Lab developed an architecture at multiple classification levels (U, S, TS) that allowed inputs at all levels fusing data at the TS-Level. Developed algorithms to assess/analyze multiple datasets. Demonstrations are scheduled for December 2016 and in support of a follow on joint staff demonstration in January 2017. At which point the project will be assessed for further development and integration. ***FY 2017 Plans:*** In FY 2017, Missile Defeat will be executing out of PE 0604132D8Z.			
Accomplishments/Planned Programs Subtotals	44.886	39.576	44.275

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Office of the Secretary Of Defense			**Date:** May 2017
Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*	**Project (Number/Name)** P535 / *Technical Intelligence*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
P535: *Technical Intelligence*	9.274	8.631	8.693	5.473	-	5.473	6.717	6.778	6.876	7.023	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Technical Intelligence Program provides global science and technology (S&T) awareness and context in order to assist Defense decision-makers plan for an uncertain future. The program uses intelligence-based and open-source information to characterize today's global S&T environment, exploiting novel technology watch and horizon scanning (TW/HS) tools to identify nascent and disruptive technologies that will shape tomorrow's future. The program complements this with tailored technical assessments that identify the military relevance, research opportunities, and policy recommendations for emerging and disruptive technologies.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Technical Intelligence ***Description:*** The Technical Intelligence Program provides global science and technology (S&T) awareness and context in order to assist Defense decision-makers plan for an uncertain future. The program uses intelligence-based and open-source information to characterize today's global S&T environment, exploiting novel technology watch and horizon scanning (TW/HS) tools to identify nascent and disruptive technologies that will shape tomorrow's future. The program complements this with tailored technical assessments that identify the military relevance, research opportunities, and policy recommendations for emerging and disruptive technologies. ***FY 2016 Accomplishments:*** In FY 2016, the Technical Intelligence program is funding efforts characterizing today's global S&T environment, exploiting novel TW/HS tools to identify nascent and disruptive technologies that will shape tomorrow's future, and developing tailored technical assessments that identify the military relevance, research opportunities, and policy recommendations of emerging and disruptive technologies. Specifically: - JASON Program: Supporting focused technical assessments on defense relevant problems. The potential topic areas include: Artificial Intelligence, defending against cooperating UAVs, and micro-satellite. - Technology Watch and Horizon Scanning (TW/HS) Tool Exploitation: Funding efforts on exploiting data analysis and TW/HS tools, to identify existing and unrecognized patterns, and to provide non-obvious relationships using open source information. The program is investigating improvements in taxonomy generation, query generation, and metrics and validation of TW/HS algorithms through partnerships with ARL and ONR. It has initiated an the transitioning technology from IARPA to the DoD developed through IARPA's Foresight and Understanding from Scientific Exposition (FUSE) program, which was a 5-year program that invested $60M-$80M into tools for TW/HS. This program is also on year 2 of a 3 year partnership with AFOSR on studying the science of emergence that is funding research at Northeastern University and University of Chicago. - Technical Assessment Program: Working on multiple technical assessment activities supporting the community of interest topic areas, including an Assessment of the field of TW/HS, Integrated Photonics, Multifunctional Structural Materials, Artificial Intelligence, Internet of Things and Synthetic Biology, and may include additional topics such as cognitive neuroscience, and	8.631	8.693	5.473

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Appropriation/Budget Activity 0400 / 2	R-1 Program Element (Number/Name) PE 0602234D8Z / *Lincoln Laboratory*	Project (Number/Name) P535 / *Technical Intelligence*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
optics and directed energy. This program funded an analysis of the vulnerability of UAV’s sense-and-avoid systems to herding behavior conducted at AFRL and Air Force University that was as a follow-on from the FY15 Autonomy assessment. ***FY 2017 Plans:*** In FY 2017, the Technical Intelligence program will continue to support efforts characterizing today’s global S&T environment, exploiting novel TW/HS tools to identify nascent and disruptive technologies that will shape tomorrow’s future, and developing tailored technical assessments that identify the military relevance, research opportunities, and policy recommendations of emerging and disruptive technologies. Specifically: - JASON Program: Will support focused technical assessments on defense relevant problems. The potential topic areas include: advanced electronics, autonomy, electronic warfare and protection, energy and power technologies, engineered resilient systems, space, sensor and processing systems, and human systems. - Technology Watch and Horizon Scanning (TW/HS) Tool Exploitation: Will continue to sponsor efforts on exploiting data analysis and TW/HS tools with the goal of having an operational TW/HS toolkit available to DoD researchers and scientists. The program will identify outreach opportunities to inform and train DoD S&T organizations in the usage of analytical tools and methodologies to support “in-house” decision making and expand organizational knowledge into emerging technology areas of strategic interest. - Technical Assessment Program: Will sponsor multiple technical assessment activities that support the community of interest topic areas, which may include advanced computing, cognitive decision-support tools, and non-traditional sensing. ***FY 2018 Plans:*** In FY 2018, the Technical Intelligence program will continue to support efforts characterizing today’s global S&T environment, exploiting novel TW/HS tools to identify nascent and disruptive technologies that will shape tomorrow’s future, and developing tailored technical assessments that identify the military relevance, research opportunities, and policy recommendations of emerging and disruptive technologies. Specifically: - JASON Program: Will no longer be supported by this PE - Technology Watch and Horizon Scanning (TW/HS) Tool Exploitation: Will continue to support the operational TW/HS toolkit, TechSight, which is available to DoD researchers and scientists, and focus on expanding it to provide quicker data analytics for TW/HS to support decision making. The program will identify outreach opportunities to inform and train DoD S&T organizations in the usage of analytical tools and methodologies to support “in-house” decision making and expand organizational knowledge into emerging technology areas of strategic interest. - Technical Assessment Program: Will sponsor multiple technical assessment activities that support the community of interest topic areas and more emphasis will be placed on conducting impact assessments of emerging technologies. - Intel Support to S&T: Will provide a bridge between the intelligence community (IC) and the S&T community to support development efforts and to produce an annual S&T Intelligence Needs Plan providing the IC a formal understanding of intelligence requirements for the S&T community.			

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Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602234D8Z / *Lincoln Laboratory*	**Project (Number/Name)** P535 / *Technical Intelligence*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018**
- Wargaming: Will provide the ability to integrate emerging threats from kill chain analysis and potentially disruptive technologies from horizon scanning efforts to the DoD Wargaming community for the improved development of realistic threats in future scenarios and the inclusion of AT&L equities in the wargaming community.			
Accomplishments/Planned Programs Subtotals	8.631	8.693	5.473

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A