Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Air Force											Date: February 2016	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603203F / *Advanced Aerospace Sensors*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	-	34.100	42.001	40.945	0.000	40.945	38.547	38.793	39.565	40.355	Continuing	Continuing
63665A: *Advanced Aerospace Sensors Technology*	-	14.919	17.443	19.547	0.000	19.547	17.734	18.258	18.620	18.992	Continuing	Continuing
6369DF: *Target Attack and Recognition Technology*	-	19.181	24.558	21.398	0.000	21.398	20.813	20.535	20.945	21.363	Continuing	Continuing

A. Mission Description and Budget Item Justification

Divided into two broad project areas, Advanced Aerospace Sensors develops technologies to enable the continued superiority of sensors from aerospace platforms. The first project area develops and demonstrates advanced technologies for electro-optical sensors, radar sensors and electronic counter-countermeasures, and components and algorithms. The second project area develops and demonstrates radio frequency (RF) and electro-optical (EO) sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets obscured by natural or man-made means. Together, the projects in this program develop the means to find, fix, target, track, and engage air and ground targets anytime, anywhere, and in any weather. This program has been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	34.334	42.183	40.945	0.000	40.945
Current President's Budget	34.100	42.001	40.945	0.000	40.945
Total Adjustments	-0.234	-0.182	0.000	0.000	0.000
• Congressional General Reductions	0.000	-0.182			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.720	0.000			
• SBIR/STTR Transfer	-0.954	0.000			
• Other Adjustments	0.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force			Date: February 2016
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603203F / *Advanced Aerospace Sensors*	Project (Number/Name) 63665A / *Advanced Aerospace Sensors Technology*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
63665A: *Advanced Aerospace Sensors Technology*	-	14.919	17.443	19.547	0.000	19.547	17.734	18.258	18.620	18.992	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project area develops and demonstrates aerospace sensor and processing technologies for intelligence, surveillance, reconnaissance (ISR), target, and attack radar applications in both manned and unmanned platforms, including electro-optical sensors and electronic counter-countermeasures for radars. It provides aerospace platforms with the capability to precisely detect, track, and target both airborne (conventional and low radar cross-section) and ground-based, high-value, time-critical targets in adverse clutter and jamming environments. Project activities include developing multi-function radio-frequency systems including radar and electronic warfare technology. Desired warfighting capabilities include the ability to detect concealed targets in difficult background conditions.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Integrated Navigation Technologies	4.910	4.484	0.000
Description: Develop and demonstrate technologies to provide precision position and timing information to enable distributed, layered sensing on air and space vehicles in Global Positioning System (GPS) degraded/denied environments. Develop technologies to maximize positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities. Simulate, develop, and demonstrate integrated navigation warfare technologies, to establish and maintain a military advantage in satellite-based navigation. ***FY 2015 Accomplishments:*** Matured GPS augmentation technologies that take advantage of distributed platforms relaying Global Navigation Satellite Systems (GNSS) signals and geo-referenced real-time imaging to improve GPS accuracy in GPS sparse or denied environments. Developed technologies that expanded the ability to incorporate GNSS signals into GPS user equipment as a means to improved navigation signal reliability and availability. ***FY 2016 Plans:*** Demonstrate GPS augmentation technologies which include use of GNSS signals with functionality to minimize point source interference while maintaining robust Position, Navigation & Timing (PNT). Continue to develop and mature technologies to incorporate GNSS capability in user equipment to include GPS Modernized Signals. Develop technologies to minimize the hardware and software overhead required on user equipment to process GNSS signals with precision. ***FY 2017 Plans:*** For FY 2017 and beyond, work accomplished under this effort will be reported in Program 0603270F, Electronic Combat Technology, in Projects 633720, EW Quick Reaction Capabilities, and 63431G, RF Warning & Countermeasures Tech.			
Title: Persistent Sensing in Contested Environment Technologies	3.174	3.341	2.358

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 63665A / *Advanced Aerospace Sensors Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Description: Develop active RF sensor solutions to use against difficult-to-detect targets in challenging environments, and advanced RF architectures for open and reconfigurable systems. Enable persistent ISR over wide areas, and detect advanced air and ground targets. ***FY 2015 Accomplishments:*** Continued research and development of high performance conformal array antenna technology, novel waveforms, Multiple Input-Multiple Output (MIMO) signal processing techniques, and cooperative RF sensing from multiple platforms in contested environments. Characterized, measured, modeled, simulated, and improved system performance of active and passive RF sensing systems in terms of RF sensing geometry, environmental phenomenology, clutter, and interference. ***FY 2016 Plans:*** Develop wideband apertures, beamforming networks, signal processing and receiver technology to support passive Electronic Support and Passive Radar modes. Continue research and development of high performance conformal array antenna technology, novel waveforms, MIMO signal processing techniques, and cooperative RF sensing from multiple platforms in contested environments. Characterize, measure, model, simulate, and improve system performance of active and passive RF sensing systems in terms of RF sensing geometry, environmental phenomenology, clutter, and interference. ***FY 2017 Plans:*** Continue research and development of wideband apertures, beamforming networks, signal processing and receiver technology to support passive Electronic Support and Passive Radar modes. Demonstrate wideband phased array and antenna technology in a laboratory environment. Demonstrate MIMO waveform characteristics and evaluate performance using laboratory assets. Develop multichannel transmit receive hardware for MIMO applications. For FY 2017 and beyond, the laser radar technology development work will be performed under the Laser Radar for Non-Cooperative Identification effort.			
Title: Passive Radio Frequency (RF) Sensing Technologies ***Description:*** Develop advanced techniques and prototype passive RF sensors to intercept, collect, locate and track enemy RF sensor systems for ISR of air and ground targets. ***FY 2015 Accomplishments:*** Continued research and development of passive multi-mode radar technology, including signal intelligence (SIGINT), airborne moving target indicator (AMTI), ground moving target indicator (GMTI), and synthetic aperture radar (SAR) imaging. Further developed sensor resource management capabilities for sensor time, energy, and waveform management, as well as optimal utilization of non-cooperative signals in the field of regard. Continued development of algorithms and hardware for passive RF	3.884	6.411	4.422

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
sensing applications, with emphasis on both high endurance at long stand-off range, and survivable, covert stand-in RF sensing within contested airspace. ***FY 2016 Plans:*** Research and develop an illumination selection manager to support passive radar functions in an anti-access/area denial (A2/AD) environment. Continue research and development of passive multi-mode radar technology, including SIGINT, AMTI, GMTI, and SAR imaging. ***FY 2017 Plans:*** Develop concepts for Distributed Passive Geolocation from multiple standoff platforms. Continue development of an illumination selection manager to support passive radar functions, including SIGINT, AMTI, and GMTI, and synthetic aperture radar (SAR) imaging in an A2/AD environment. For FY 2017 and beyond, Passive Sensing work accomplished under this effort will be reported under the Passive EO Sensing for Surveillance and Reconnaissance effort.			
Title: Long Range Sensing Technologies ***Description:*** Develop RF sensor technology to detect, locate, and identify air and ground targets at long ranges, including those that are low-observable, or use deception or camouflage. ***FY 2015 Accomplishments:*** Extended GMTI and SAR techniques developed for detection and tracking of dismounts and high value mobile ground targets from high angle, close-in RF sensing scenarios to low angle, long stand-off RF sensing geometric scenarios with A2/AD. Revised and extended prior radar systems engineering and develop improved algorithms and multi-static cooperative radar techniques to address the challenges of long stand-off RF sensing in A2/AD airspace. ***FY 2016 Plans:*** Continue to develop improved algorithms for low grazing angle, long stand-off GMTI and SAR. Collect data for testing of algorithms. Revise and extend prior radar systems engineering and develop improved algorithms and multi-static cooperative radar techniques to address the challenges of long stand-off RF sensing in A2/AD airspace. Develop technology to enable multi-function RF systems. Develop simulation models that combine radio frequency and electro-optical/infrared sensors with a sensor resource manager. Continue to demonstrate open architecture constructs that enable rapid technology refresh in RF systems. ***FY 2017 Plans:***	2.951	3.207	2.212

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Design a radar pod for long stand-off sensing that includes advanced GMTI and SAR modes tailored for long stand-off. Include a sensor resource manager and infrared search and track system in the design of the sensor package. Extend open architecture constructs to incorporate electronic warfare and communication functions. Continue to develop radar systems and algorithms for multi-static cooperative radar to address the challenges of long stand-off RF sensing in A2/AD airspace. Collect multi-static data with cooperative targets to test algorithms. For FY 2017 and beyond, the laser radar technology development work will be performed under the Laser Radar for Non-Cooperative Identification effort.			
Title: Passive EO Sensing for Surveillance and Reconnaissance Technologies	0.000	0.000	6.778
Description: Advance, demonstrate, and transition innovative imaging and non-imaging optical sensing technologies for surveillance and reconnaissance of airborne and ground-based objects of interest in an A2/AD environment. This effort includes the development of systems, subsystems, and components necessary to yield new capabilities. ***FY 2015 Accomplishments:*** N/A ***FY 2016 Plans:*** N/A ***FY 2017 Plans:*** In FY 2015 and FY 2016, the work for this effort originally was performed under Passive Radio Frequency (RF) Sensing Technologies effort and the Long Range Sensing Technologies effort. Advance and refine engineering trades and system optimization, via modeling, simulation, and test, of innovative sensor concepts to increase long range image quality for passive electro-optical and infrared reconnaissance sensors beyond the current state of the art and show connections to documented requirements. Continue development and refinement of advanced prototypes for hyperspectral imaging and infrared search and track sensors to achieve operationally useful radiometric sensitivity, detection performance, and area coverage rates. Reduce the number of candidate architectures through analysis and measurement, when possible. Prepare and conduct technology demonstrations to advance system, subsystem, and component technology readiness levels (TRL) as required.			
Title: Laser Radar for Non-Cooperative Identification	0.000	0.000	3.777

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Description: Advance, demonstrate, and transition innovative laser radar sensing technologies for non-cooperative identification of airborne and ground objects of interest in an A2/AD environment. This effort includes the development of systems, subsystems, and components necessary to yield new capabilities. ***FY 2015 Accomplishments:*** N/A ***FY 2016 Plans:*** N/A ***FY 2017 Plans:*** In FY 2015 and FY 2016, the work was originally performed under the Persistent Sensing in Contested Environment Technologies effort and the Long Range Sensing Technologies effort. Refine Synthetic Aperture Laser Radar (SAL) technology demonstrators under development based on modeling and simulation to enhance spatial resolution beyond the diffraction limit of conventional optics. Continue research on technologies, architectures and components needed for improving system capabilities to provide high confidence target identification at standoff ranges for both reconnaissance and targeting platforms. Integrate these technologies when sufficiently mature. Fabricate, characterize, and test critical components for a long range SAL demonstration. Refine sensor product visualization and automatic target recognition by applying previous phenomenology research in collaboration with other Air Force Research Laboratory Technology Directorates. Increase emphasis on applications for long range air-to-air ladar, updating modeling and simulation to support system design and analysis of alternatives. Prepare and conduct technology demonstrations to advance system, subsystem, and component TRL as required.			
Accomplishments/Planned Programs Subtotals	14.919	17.443	19.547

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
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E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force			Date: February 2016
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603203F / *Advanced Aerospace Sensors*	Project (Number/Name) 6369DF / *Target Attack and Recognition Technology*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
6369DF: *Target Attack and Recognition Technology*	-	19.181	24.558	21.398	0.000	21.398	20.813	20.535	20.945	21.363	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project area develops and demonstrates advanced technologies for attack management, fire control, and target identification and recognition. This includes developing and demonstrating integrated and cooperative fire control techniques to provide for adverse-weather precision air strikes against multiple targets per pass and at maximum weapon launch ranges. Specific fire control technologies under development include attack management, sensor fusion, automated decision aids, advanced tracking for low radar cross section threats, and targeting using both on-board and off-board sensor information. This project area also evaluates targeting techniques to support theater missile defense efforts in surveillance and attack. These fire control technologies will provide force multiplication and reduce warfighter exposure to hostile fire. This project area also develops and demonstrates target identification and recognition technologies for positive, high confidence cueing, recognition, and identification of airborne and ground-based, high-value, time-critical targets at longer ranges than are currently possible. The goal is to apply these technologies to tactical air-to-air and air-to-surface weapon systems so they are able to operate in all weather conditions, during day or night, and in high-threat, multiple target environments. Model-based vision algorithms and target signature development techniques are the key to target identification and recognition. This project is maturing these technologies in partnership with the Defense Advanced Research Projects Agency (DARPA) and evaluating the techniques to support theater missile defense efforts in surveillance and attack. Fire control and recognition technologies developed and demonstrated in this project area are high leverage efforts, providing for significant advancements in operational capabilities largely through software improvements readily transitionable to new and existing weapon systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Integrated Sensor Targeting Technologies	3.570	4.564	3.960
Description: Develop an advanced suite of sensors with automatic target recognition, fusion, and target tracking, all working in concert to provide a high-confidence identification capability.			
FY 2015 Accomplishments: Continued assessing integrated sensor targeting technologies for permissive environments which could serve as candidate solutions for Planning and Direction, Collection, Processing and Exploitation, Analysis and Production, and Dissemination (PCPAD) in contested environments. Created target signature databases from electro-optical, synthetic aperture radar, and multi-source sensor data for targets representing the highest priority threat systems.			
FY 2016 Plans: Demonstrate phenomenology-derived feature toolkit for high resolution characterization of salient RF and EO features for select targets; Initiate development and assessment of reduced feature set target models and update target signature database; Demonstrate salient feature extraction for distributed radar and ladar. Initiate challenge problem development for assessment of reduced target feature sets in PCPAD-experimental (PCPAD-X). Continue development of applications to utilize target signature			

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Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 6369DF / *Target Attack and Recognition Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
databases from electro-optical, synthetic aperture radar, and multi-source sensor data for targets representing the highest priority threat systems. ***FY 2017 Plans:*** Demonstrate phenomenology-derived feature toolkit for high resolution characterization of salient RF and EO features for select targets. Continue development and assessment of reduced feature set target models and update target signature database. Demonstrate salient feature extraction for distributed radar and ladar. Demonstrate applications to utilize target signature databases from electro-optical, synthetic aperture radar, and multisource sensor data for targets representing the highest priority threat systems.			
Title: Multi-Sensor Target Recognition ***Description:*** Develop and assess multi-sensor automatic target recognition for intelligence, surveillance, reconnaissance, strike, and weapon systems. ***FY 2015 Accomplishments:*** Continued development of target signature formation techniques from single and multiple cooperating sensors, and sensors and signals of opportunity. Created experiments for demonstrating the contributions of promising technologies to address deficiencies in automatic target recognition for select classes of targets in contested environments. ***FY 2016 Plans:*** Initiate development of applications to characterize and suppress clutter in bi-static and passive RF sensors; Initiate development of advanced tracking algorithms for bi-static and passive RF sensors; Continue multi-sensor data collections for RF and EO sensors; Demonstrate and characterize accuracy in uncertainty estimation for vision-aided navigation and geo-registration; Demonstrate onboard image processing on unmanned air systems for insertion into information fusion and decision making systems; Conduct PCPAD-X assessments of multi-sensor tracking and change detection applications for mobile targets in contested environments. ***FY 2017 Plans:*** Continue development of applications to characterize and suppress clutter in bistatic and passive RF sensors. Continue development of advanced tracking algorithms for bistatic and passive RF sensors. Continue multisensory data collections for RF and EO sensors. Demonstrate and characterize accuracy in uncertainty estimation for vision-aided navigation and geo-registration. Develop multi-sensor exploitation and fusion methods for use by analysts.	8.169	10.142	8.800
Title: Wide-Angle, Continuously-Staring Technologies ***Description:*** Develop wide angle, continuous staring, multi-sensor/wavelength sensing and automated exploitation technology to detect, track, and identify targets over large areas at low sensor update rates.	7.442	9.852	8.638

Exhibit R-2A, RDT&E Project Justification: PB 2017 Air Force		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
FY 2015 Accomplishments: Continued development of stand-off (air and space) and episodic stand-in sensing capabilities for contested and denied environments. Continued development of exploitation algorithms, phenomenological modeling, image formation, and target and scenario databases necessary to support transition of staring sensing capabilities to the warfighter. Continued to integrate, demonstrate and evaluate enhanced wide angle and wide area sensing and exploitation technologies in conditions representative of contested and denied environments. ***FY 2016 Plans:*** Demonstrate tracking, change detection, and image processing capabilities for data representative of contested and denied environments; Collect, process, and catalogue data from advanced wide-angle sensor; Demonstrate reduced Size, Weight and Power (SWaP) image processing and change detection from large SAR data sets; Demonstrate improved geo-registration and PNT from wide-area EO imagery; Continue development of stand-off (air and space) and episodic stand-in sensing capabilities for contested and denied environments. ***FY 2017 Plans:*** Demonstrate tracking, change detection, and image processing capabilities for data representative of contested and denied environments. Collect, process, and catalogue data from advanced wide-angle sensor. Develop feature aided tracking methods for wide angle RF sensors. Continue development of stand-off (air and space) and episodic stand-in sensing capabilities for contested and denied environments.			
Accomplishments/Planned Programs Subtotals	19.181	24.558	21.398

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.