Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Air Force											Date: May 2017	
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 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	-	39.794	40.945	40.978	0.000	40.978	43.010	45.125	48.158	49.676	Continuing	Continuing
63665A: *Advanced Aerospace Sensors Technology*	-	16.443	19.547	19.734	0.000	19.734	21.258	21.620	21.992	22.372	Continuing	Continuing
6369DF: *Target Attack and Recognition Technology*	-	23.351	21.398	21.244	0.000	21.244	21.752	23.505	26.166	27.304	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 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Previous President's Budget	42.001	40.945	38.547	0.000	38.547
Current President's Budget	39.794	40.945	40.978	0.000	40.978
Total Adjustments	-2.207	0.000	2.431	0.000	2.431
• Congressional General Reductions	0.000	0.000			
• 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	-1.139	0.000			
• SBIR/STTR Transfer	-1.068	0.000			
• Other Adjustments	0.000	0.000	2.431	0.000	2.431

Change Summary Explanation

Decrease in FY 2016 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2358.

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Increase in FY 2018 is a realignment of funds for increased integrated technology demonstrations.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force			Date: May 2017
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 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
63665A: *Advanced Aerospace Sensors Technology*	-	16.443	19.547	19.734	0.000	19.734	21.258	21.620	21.992	22.372	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 2016	FY 2017	FY 2018
Title: Integrated Navigation Technologies	4.227	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 2016 Accomplishments:*** Demonstrated GPS augmentation technologies which include use of Global Navigation Satellite System (GNSS) signals with functionality to minimize point source interference while maintaining robust position, navigation & timing (PNT). Continued to develop and mature technologies to incorporate GNSS capability in user equipment to include GPS Modernized Signals. Developed 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	3.150	2.358	2.381
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.			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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 2016	FY 2017	FY 2018
FY 2016 Accomplishments: Developed wideband apertures, beamforming networks, signal processing and receiver technology to support passive Electronic Support and Passive Radar modes. 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 congested electromagnetic environments. Characterized and simulated system performance of active and passive RF sensing systems (measured and modeled environments) in terms of RF sensing geometry, environmental phenomenology, clutter, and interference. ***FY 2017 Plans:*** For FY 2017 and beyond, the laser radar technology development work will be performed under the Laser Radar for Non-Cooperative Identification effort. Continue research and development of wideband apertures, beamforming networks, signal processing and receiver technology to support electronic support and passive radar modes. Demonstrate wideband phased array and antenna technology in a laboratory and RF range environments. Demonstrate MIMO waveform characteristics and evaluate performance using laboratory assets. ***FY 2018 Plans:*** Develop multichannel transmit and receive hardware for distributed MIMO applications. Explore methodologies for coherent signal processing modes supporting electronic support and passive radar receivers.			
Title: Passive Radio Frequency (RF) Sensing Technologies	6.043	4.422	4.464
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 2016 Accomplishments:*** Researched an illumination selection manager to support passive radar functions in an anti-access/area denial (A2/AD) environment. Continued research and data analysis of passive multi-mode radar technology, including signals intelligence (SIGINT), airborne moving target indicator (AMTI), ground moving target indicator (GMTI), and synthetic aperture radar (SAR) imaging. Demonstrated technique for significantly increasing useful range of a passive EO/IR ISR sensor beyond the current state of the art. ***FY 2017 Plans:***			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
For FY 2017 and beyond, Passive EO Sensing work accomplished under this effort will be reported under the Passive EO Sensing for Surveillance and Reconnaissance effort. Develop concepts for Distributed Passive Geolocation from multiple standoff platforms. Continue development of an illumination selection manager to support passive radar functions, including signals intelligence (SIGINT), airborne moving target indicator (AMTI), ground moving target indicator (GMTI), and synthetic aperture radar (SAR) imaging in an A2/AD environment. ***FY 2018 Plans:*** Conduct a laboratory-based critical experiment 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.			
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 2016 Accomplishments:*** Developed improved algorithms for low grazing angle, long stand-off GMTI and SAR. Collected data for testing of algorithms. Extended prior radar systems engineering and developed improved algorithms and multi-static cooperative radar techniques to address the challenges of long stand-off RF sensing in A2/AD airspace. Demonstrated significant subsystem breakthrough critical to advancing synthetic aperture ladar technology demonstration currently under development. ***FY 2017 Plans:*** For FY 2017 and beyond, Passive EO Sensing work accomplished under this effort will be reported under the Passive EO Sensing for Surveillance and Reconnaissance effort. Develop concepts for Distributed Passive Geolocation from multiple standoff platforms. Continue development of an illumination selection manager to support passive radar functions, including signals intelligence (SIGINT), airborne moving target indicator (AMTI), ground moving target indicator (GMTI), and synthetic aperture radar (SAR) imaging in an A2/AD environment. ***FY 2018 Plans:*** Extend open architecture constructs to incorporate electronic warfare and communication functions.	3.023	2.212	2.233

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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 2016	FY 2017	FY 2018
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.			
Title: Passive EO Sensing for Surveillance and Reconnaissance Technologies ***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 2016 Accomplishments:*** N/A ***FY 2017 Plans:*** In 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. Continue testing of prototyped strategy for improving the useful range of passive electro-optical and infrared reconnaissance sensors beyond the current state of the art. Advance and refine engineering trades and system optimization, via modeling, simulation, and laboratory test, of innovative sensor concepts. 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. Test candidate systems and subsystems in a laboratory environment. Prepare and conduct technology demonstrations to advance system, subsystem, and component technology readiness levels (TRL) as required. Initiate subsystem development critical to meeting performance requirements for advanced infrared search and track systems. ***FY 2018 Plans:*** Refine and integrate advanced subsystem technology for infrared search and track systems. Test in a laboratory environment to enhance subsystem technology readiness level. Advance refinement of prototypes for longwave infrared hyperspectral imaging to achieve operationally useful radiometric sensitivity, detection performance, and area coverage rates. Test candidate systems and subsystems in a laboratory environment. Initiate refinement and prototyping of novel software/hardware combined sensing strategy for turbulence mitigation in passive EO/IR reconnaissance systems to improve the useful range beyond the current state of the art. Advance and refine engineering trades and system optimization for this novel approach, through modeling and simulation.	0.000	6.778	6.843
Title: Laser Radar for Non-Cooperative Identification	0.000	3.777	3.813

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
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 2016 Accomplishments:*** N/A ***FY 2017 Plans:*** In 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 equivalent optical apertures. 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. Fabricate, characterize, and test critical components for a long range SAL demonstration in a laboratory environment. Refine sensor product visualization and automatic target recognition by applying previous phenomenology. Increase emphasis on applications for long range air-to-air ladar, updating modeling and simulation to support system design and analysis of alternatives. Conduct technology demonstrations to advance system, subsystem, and component TRL as required. ***FY 2018 Plans:*** Refine and test SAL technology demonstrators under development based on modeling and simulation to enhance spatial resolution beyond the diffraction limit of equivalent optical apertures. Fabricate, characterize, and test critical components and subsystems for a SAL demonstration in a laboratory environment. Continue research on components needed for improving system capabilities to provide high confidence identification at standoff ranges. Integrate these technologies into a prototype architecture if judged sufficiently mature. Advance sensor automatic target recognition software by applying previous phenomenology research and advanced mathematical concepts. Continue emphasizing long range air-to-air ladar concepts through modeling and simulation to support system design and analysis of alternatives. Prepare for future technology demonstrations to advance system, subsystem, and component TRL.			
Accomplishments/Planned Programs Subtotals	16.443	19.547	19.734

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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C. Other Program Funding Summary ($ in Millions)

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.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force			Date: May 2017
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 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
6369DF: *Target Attack and Recognition Technology*	-	23.351	21.398	21.244	0.000	21.244	21.752	23.505	26.166	27.304	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 2016	FY 2017	FY 2018
Title: Integrated Sensor Targeting Technologies	4.340	3.960	3.932
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 2016 Accomplishments: Demonstrated phenomenology-derived feature toolkit for high resolution characterization of salient RF and EO features for select targets; Initiated development and assessment of reduced feature set target models and update target signature database; demonstrated salient feature extraction for distributed radar and ladar. Continued development of applications to utilize target signature databases from electro-optical, synthetic aperture radar, and multi-source sensor data for targets representing the highest priority threat systems. Initiated challenge problem development for assessment of reduced target feature sets in PCPAD-experimental (PCPAD-X).			
FY 2017 Plans: Continue development and assessment of reduced feature set target models and update target signature database; continue development of applications to utilize target signature databases from electro-optical, synthetic aperture radar, and multi-source			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
sensor data for targets representing the highest priority threat systems. Demonstrate phenomenology-derived feature toolkit for high resolution characterization of salient RF and EO features for select targets; demonstrate salient feature extraction for distributed radar and ladar. ***FY 2018 Plans:*** Continue development and assessment of reduced feature set target models and update target signature database. Demonstrate phenomenology-derived feature toolkit for high resolution characterization of salient RF and EO features for select targets.			
Title: Multi-Sensor Target Recognition ***Description:*** Develop and assess multi-sensor automatic target recognition for intelligence, surveillance, reconnaissance, strike, and weapon systems. ***FY 2016 Accomplishments:*** Demonstrated and characterized accuracy in uncertainty estimation for vision-aided navigation and geo-registration; demonstrated onboard image processing on unmanned air systems for insertion into information fusion and decision making systems; conducted PCPAD-X assessments of multi-sensor tracking and change detection applications for mobile targets in contested environments. Continued multi-sensor data collections for RF and EO sensors; initiated development of applications to characterize and suppress clutter in bi-static and passive RF sensors; initiated development of advanced tracking algorithms for bi-static and passive RF sensors. ***FY 2017 Plans:*** Continue development of applications to characterize and suppress clutter in 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 tracking and change detection applications for mobile targets in contested environments. Develop multi-sensor exploitation and fusion methods for use by analysts. Initiate development of advanced tracking algorithms for bi-static and passive RF sensors. ***FY 2018 Plans:*** Continue development of applications to characterize and suppress clutter in 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. Demonstrate multi-sensor exploitation and fusion methods for use by analysts. Initiate development of advanced tracking algorithms for bistatic and passive RF sensors.	9.643	8.800	8.737
Title: Wide-Angle Continuously-Staring Technologies	9.368	8.638	8.575

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
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. ***FY 2016 Accomplishments:*** Demonstrated tracking, change detection, and image processing capabilities for data representative of contested and denied environments; collected, process, and catalogue data from advanced wide-angle sensor; demonstrated reduced size, weight and power (SWaP) image processing and change detection from large SAR data sets; demonstrated improved geo-registration and PNT from wide-area EO imagery; continued development of stand-off (air and space) and episodic stand-in sensing capabilities for contested and denied environments. ***FY 2017 Plans:*** Continue development of stand-off (air and space) and episodic stand-in sensing capabilities for contested and denied environments. 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. ***FY 2018 Plans:*** Continue development of stand-off (air and space) and episodic stand-in sensing capabilities for contested and denied environments. 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.			
Accomplishments/Planned Programs Subtotals	23.351	21.398	21.244

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.