Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Air Force										DATE: February 2011	
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*							
COST ($ in Millions)	**FY 2010**	**FY 2011**	**FY 2012 Base**	**FY 2012 OCO**	**FY 2012 Total**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**	**Cost To Complete**	**Total Cost**
Total Program Element	136.335	157.497	134.787	-	134.787	137.101	141.434	144.405	147.299	Continuing	Continuing
622002: *Electronic Component Technology*	40.304	34.458	42.872	-	42.872	43.623	50.231	51.825	52.860	Continuing	Continuing
622003: *EO Sensors & Countermeasures Tech*	18.298	21.430	28.051	-	28.051	29.005	29.940	30.534	31.159	Continuing	Continuing
624916: *Electromagnetic Tech*	18.712	18.905	-	-	-	-	-	-	-	Continuing	Continuing
626095: *Sensor Fusion Technology*	23.249	27.008	24.545	-	24.545	25.014	25.512	25.731	26.234	Continuing	Continuing
627622: *RF Sensors & Countermeasures Tech*	35.772	55.696	39.319	-	39.319	39.459	35.751	36.315	37.046	Continuing	Continuing

Note

Note: In FY 2012 the efforts in Project 624916 move from Hanscom AFB, MA to Wright Patterson AFB, OH due to the decisions of the Base Realignment and Closure Commission. The individual efforts from Project 624916 are merged into other existing Projects in this PE.

A. Mission Description and Budget Item Justification

This program develops the technology base for Air Force aerospace sensors and electronic combat. Advances in aerospace sensors are required to increase combat effectiveness by providing anytime, anywhere surveillance, reconnaissance, precision targeting, and electronic warfare capabilities. To achieve this progress, this program pursues simultaneous advances in: 1) generating, controlling, receiving, and processing electronic and photonic signals for radio frequency (RF) sensor aerospace applications; 2) electro-optical (EO) aerospace sensor technologies for a variety of offensive and defensive uses; 3) radio frequency antennas and associated electronics for airborne and space surveillance, together with active and passive electro-optical sensors; 4) technologies to manage and fuse on-board sensor information for timely, comprehensive situational awareness; and 5) technology for reliable, all-weather surveillance, reconnaissance, and precision strike radio frequency sensors and electronic combat systems. This program has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary sensor, electronics, and electronic combat technologies.

Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Air Force	DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602204F: *Aerospace Sensors*

B. Program Change Summary ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Previous President's Budget	136.012	157.497	137.261	-	137.261
Current President's Budget	136.335	157.497	134.787	-	134.787
Total Adjustments	0.323	-	-2.474	-	-2.474
• Congressional General Reductions		-			
• Congressional Directed Reductions		-			
• Congressional Rescissions	-	-			
• Congressional Adds		-			
• Congressional Directed Transfers		-			
• Reprogrammings	1.520	-			
• SBIR/STTR Transfer	-1.123	-			
• Other Adjustments	-0.074	-	-2.474	-	-2.474

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2010	FY 2011
Project: 622002: *Electronic Component Technology*		
Congressional Add: *Advanced Electronic Components for Sensor Arrays*	2.390	-
Congressional Add: *Advanced Integrated Microsystems for Military Electronic Systems*	2.470	-
Congressional Add: *On-Chip Integrated Photonic Polymer Transceiver*	4.481	-
Congressional Add Subtotals for Project: 622002	9.341	-
Project: 622003: *EO Sensors & Countermeasures Tech*		
Congressional Add: *Watchkeeper*	1.593	-
Congressional Add Subtotals for Project: 622003	1.593	-
Project: 626095: *Sensor Fusion Technology*		
Congressional Add: *Information Quality Tools for Persistent Surveillance Data Sets.*	1.434	-
Congressional Add: *Net-centric Sensor Grids.*	2.390	-
Congressional Add Subtotals for Project: 626095	3.824	-
Congressional Add Totals for all Projects	14.758	-

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
622002: *Electronic Component Technology*	40.304	34.458	42.872	-	42.872	43.623	50.231	51.825	52.860	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project focuses on generating, controlling, receiving, and processing electronic signals for radio-frequency sensor aerospace applications. The enabling technologies developed under this project will be used for intelligence, surveillance, reconnaissance (ISR), electronic warfare, battlespace access, and precision engagement capabilities. The technologies developed include exploratory device concepts; solid state power devices and amplifiers; low noise and signal control components; photonic components; high-temperature electronics; signal control and distribution; signal processing; multi-function monolithic integrated circuits; high-speed analog-to-digital and digital-to-analog mixed mode integrated circuits; reconfigurable electronics; power distribution; multi-chip modules; and high density packaging and interconnect technologies. This project also designs, develops, fabricates, and evaluates techniques for integrating combinations of these electronic component technologies. The project aims to demonstrate significantly improved military sensors of smaller size, lower weight, lower cost, lower power dissipation, higher reliability, and improved performance. The device and component technology developments under this project are military unique; they are based on Air Force and other Department of Defense weapon systems requirements in the areas of radar, communications, electronic warfare, navigation, and smart weapons.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Title: Major Thrust 1. ***Description:*** Develop compact, affordable, multi-function components for aerospace sensors. Develop advanced electronic and optoelectronic aperture subsystems for affordable and scalable sensors. ***FY 2010 Accomplishments:*** Demonstrated prototype wideband digital channel. Developed and exploited metamaterials for electronic and optoelectronic applications. Demonstrated sensing subsystem using most promising metamaterials technology. ***FY 2011 Plans:*** Demonstrate and transition sensing and/or electronic warfare subsystem using metamaterials approaches. ***FY 2012 Base Plans:*** Continue to demonstrate and transition sensing and/or electronic warfare subsystems using metamaterials approaches. ***FY 2012 OCO Plans:***	6.368	9.975	12.237	-	12.237
Title: Major Thrust 2.	4.255	4.692	6.033	-	6.033

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Description: Develop new microelectronic component and fabrication technologies for sensors and communications to support ISR, precision strike, and battlespace access. ***FY 2010 Accomplishments:*** Demonstrated closed-loop modeling and prediction capability for emerging electronic device performance versus lifetime in militarily relevant environments. Investigated and tested innovative electronic device concepts for wideband, reconfigurable and tunable applications. ***FY 2011 Plans:*** Demonstrate predictive capability for a larger variety of emerging electronic devices to map performance versus lifetime in militarily relevant environments. Identify key failure mechanisms for previously prioritized electronic device technologies and their corresponding accelerants and chemistry. Fabricate and test innovative electronic device concepts for wideband, reconfigurable and tunable applications. ***FY 2012 Base Plans:*** Continue to fabricate and characterize innovative electronic device concepts for wideband, reconfigurable and tunable applications. ***FY 2012 OCO Plans:***					
Title: Major Thrust 3. ***Description:*** Develop optoelectronics for next generation imaging and electronic warfare sensors. Develop electro-optical devices for next-generation warfighter applications. ***FY 2010 Accomplishments:*** Demonstrated compact, efficient, high-brightness sources, optically- and/or electrically-pumped. Started the development for compact, tunable detector technology for advanced multi-spectral applications. Developed optical waveform generation subsystems. Initiated effort for combined spectral and polarimetric filtering at detector pixel level, extending to next-generation spectro-polarimetric focal plane array development. ***FY 2011 Plans:***	3.817	4.692	6.033	-	6.033

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Continue development of agile/affordable advanced detector arrays with emphasis on combined spectro-polarimetric filtering. Start application development of high-brightness and agile waveform sources for integration into components and subsystems. ***FY 2012 Base Plans:*** Demonstrate prototype hardware for agile/affordable advanced detector arrays with emphasis on combined spectro-polarimetric filtering. Continue application development of high-brightness and agile waveform sources for integration into components and subsystems. ***FY 2012 OCO Plans:***					
Title: Major Thrust 4. ***Description:*** Develop, fabricate, and test electronic and optoelectronic devices and techniques to reduce power loss and power consumption for future imaging, electronic warfare, and ISR sensors. ***FY 2010 Accomplishments:*** Demonstrated tunable and reconfigurable electronic and optoelectronic components for combined imaging and electronic warfare applications. Developed solutions for energy starved applications. ***FY 2011 Plans:*** Refine and transition solutions for multi-function electronic and optoelectronic components for imaging and electronic warfare applications. ***FY 2012 Base Plans:*** Continue to refine and transition solutions for multi-function electronic and optoelectronic components for imaging and electronic warfare applications. ***FY 2012 OCO Plans:***	8.689	8.024	10.071	-	10.071
Title: Major Thrust 5. ***Description:*** Develop and demonstrate innovative radio-frequency component technology to lower system cost through reduction of part count, chip size, and design, production, and integration costs. ***FY 2010 Accomplishments:***	1.066	-	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Designed and developed highly reconfigurable fully programmable microwave array and flexible optoelectronic integrated circuits using highly integrated techniques for lighter weight radio-frequency and optical apertures. ***FY 2011 Plans:*** ***FY 2012 Base Plans:*** ***FY 2012 OCO Plans:***					
Title: Major Thrust 6. ***Description:*** Develop integrated design, modeling and simulation tools, and integration techniques for complex mixed-signal component development in advanced electronic component technologies. ***FY 2010 Accomplishments:*** Extended design and characterization capability to tunable, reconfigurable and multi-function electronic and optoelectronic devices and components. ***FY 2011 Plans:*** Employ design, modeling, and simulation tools and integration techniques for complex mixed-technology (digital, radio-frequency, microwave, optical, mechanical) component development in both advanced and emerging electronic component technologies. ***FY 2012 Base Plans:*** Develop and demonstrate prototypes of complex mixed-technology (digital, radio-frequency, microwave, optical, and mechanical) components using both advanced and emerging electronic component technologies. ***FY 2012 OCO Plans:***	5.127	5.670	7.327	-	7.327
Title: Major Thrust 7. ***Description:*** Develop advanced component and subsystem technologies for space-base sensors that focuses on improving performance and reducing size, mass, and prime power. ***FY 2010 Accomplishments:***	1.641	1.405	1.171	-	1.171

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Developed reconfigurable/tunable high performance electronics/circuits. Investigated pre-space qualification issues associated with newer component technologies to ensure more rapid and accurate transitions. Developed scalable/reconfigurable plug-and-play payload building blocks. ***FY 2011 Plans:*** Develop and demonstrate a capability to predict performance versus lifetime in military relevant environments for a larger variety of emerging electronic devices. Identify key failure mechanisms for electronic device technologies and their corresponding accelerants and chemistry. ***FY 2012 Base Plans:*** Continue to develop and demonstrate a capability to predict performance versus lifetime in military relevant environments for a larger variety of emerging electronic devices. Identify key failure mechanisms for electronic device technologies and their corresponding accelerants and chemistry. ***FY 2012 OCO Plans:***					
Accomplishments/Planned Programs Subtotals	30.963	34.458	42.872	-	42.872

	FY 2010	FY 2011
Congressional Add: Advanced Electronic Components for Sensor Arrays ***FY 2010 Accomplishments:*** Conducted Congressionally-directed effort. ***FY 2011 Plans:***	2.390	-
Congressional Add: Advanced Integrated Microsystems for Military Electronic Systems ***FY 2010 Accomplishments:*** Conducted Congressionally-directed effort. ***FY 2011 Plans:***	2.470	-
Congressional Add: On-Chip Integrated Photonic Polymer Transceiver ***FY 2010 Accomplishments:*** Conducted Congressionally-directed effort. ***FY 2011 Plans:***	4.481	-
Congressional Adds Subtotals	9.341	-

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622002: *Electronic Component Technology*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
• Activity Not Provided: *Title Not Provided*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

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: PB 2012 Air Force			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
622003: *EO Sensors & Countermeasures Tech*	18.298	21.430	28.051	-	28.051	29.005	29.940	30.534	31.159	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project determines the technical feasibility of advanced electro-optical aerospace sensor technologies for a variety of offensive and defensive uses. The sensor technologies under development range from the ultraviolet through the infrared portion of the spectrum. Related efforts include improvements in avionics integration, digital processing, analysis tools, and sensor architectures. One of the project's main goals is to improve electro-optical and related technologies for the detection, tracking, and identification of non-cooperative and difficult targets, such as those obscured by camouflage. This project also develops the passive and active imaging sensors and algorithms needed to enable precision targeting in severe weather. These technologies are critical to future aerospace surveillance and targeting. Other project goals include advanced electro-optical threat warning and countermeasures.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Title: Major Thrust 1.	2.292	10.972	16.373	-	16.373
Description: Develop technology for non-cooperative detection and identification of airborne and ground-based targets.					
FY 2010 Accomplishments: Performed sensor concept demonstrations for long range target identification using passive and active techniques, including multispectral/polarimetric imaging, vibrometry, sparse aperture and synthetic aperture laser radar. Developed fused active and passive, multi-discriminant image products based on individual and combined measurement performance. Characterized hybrid focal planes and demonstrated in short range laser radar systems. Began design of multi-discriminant system utilizing common components to minimize size and optimize utility. Enhanced optical sensor for improved space situation awareness experiments.					
FY 2011 Plans: Continue sensor concept demonstrations for long range target identification using passive and active techniques, including multispectral/polarimetric imaging, vibrometry, 3-D, sparse aperture and synthetic aperture laser radar. Refine techniques for long range object reconstruction based on either multi-aspect multispectral and polarimetric images or coherent laser radar data, with particular emphasis on synthetic and sparse aperture imaging techniques. Continue signature collection experiments with multispectral/polarimetric imaging systems to assess military utility. Perform proof of concept experiments to assess potential utility.					
FY 2012 Base Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Continue sensor concept demonstrations for long range target identification using passive and active techniques, including multispectral/polarimetric imaging, vibrometry, 3-D, sparse aperture and synthetic aperture laser radar. Demonstrate techniques for long range object reconstruction based on multi-aspect multispectral and polarimetric images and coherent laser radar data. Extend signature collection experiments with multispectral/ polarimetric imaging systems to incorporate the impact of multi-aspect imaging for shape extraction. Investigate atmospheric turbulence issues related to synthetic aperture imaging. Perform field experiments, quantify potential utility, and initiate concept development for airborne demonstrations. Develop model-based algorithms for longwave hyperspectral change detection. ***FY 2012 OCO Plans:***					
Title: Major Thrust 2. ***Description:*** Develop optical transmitter and agile aperature technology capable of sensing multiple target characteristics for robust non-cooperative target identification. ***FY 2010 Accomplishments:*** Completed testing of optical transmitter technologies for non-cooperative target identification at long standoff ranges. Refined optimal system concepts using advanced active and passive sensor models with emphasis on imaging through scattering media such as clouds and foliage. Developed enabling sensor components for a demonstration system. ***FY 2011 Plans:*** Initiate development of beamsteering technology for long range sparse aperture and compact 3-D laser radar systems. Assess characteristics of beamsteering component technologies based on liquid crystal, micro electro-mechanical systems, and other optical phased array concepts. ***FY 2012 Base Plans:*** Continue development of beamsteering technology for sparse aperture and compact 3-D laser radar systems. Perform characterization of beamsteering component technologies based on liquid crystal, microwave electro-mechanical modules, and other optical phased array concepts. Initiate proof of concept experiments for an agile aperture assembly. Develop design concepts for wideband optical detector arrays suitable for coherent laser radar systems. Define and implement optimized waveforms for laser-based sensing. Continue active and passive sensor phenomenology experiments and model development. ***FY 2012 OCO Plans:***	0.503	1.262	2.590	-	2.590

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Title: Major Thrust 3. ***Description:*** Develop innovative techniques and components to target difficult objects in battlefield environments, including dynamic targets in urban areas. ***FY 2010 Accomplishments:*** Developed techniques for targeting difficult objects in dynamic urban environments. Explored compact active and passive sensor components with advanced signal processing for distributed operation from small platforms to provide close-in sensing of difficult targets in obscured and urban areas. Demonstrated individual sensor components for close in sensing from small remotely piloted aircraft (SRPA) in difficult environments. Conducted flight phenomenology experiments supporting ladar applications on SRPA. ***FY 2011 Plans:*** ***FY 2012 Base Plans:*** ***FY 2012 OCO Plans:***	5.958	-	-	-	-
Title: Major Thrust 4. ***Description:*** Develop countermeasure technologies for use against infrared- and electro-optical guided missiles threats. ***FY 2010 Accomplishments:*** Assessed technologies to defeat advanced infrared missiles and infrared acquisition sensors. Supported demonstration of proactive detection, discrimination, and defeat of second-generation infrared-imaging missile seekers and sensors systems. Refined techniques and discrimination processes test data. Developed and refined simulation capability to evaluate effectiveness across mission concepts of employment. ***FY 2011 Plans:*** Continue the assessment of advanced infrared missiles and infrared acquisition sensors. Continue to develop proactive infrared countermeasures including the detection, discrimination, and defeat of second-generation, infrared, imaging missile seekers and sensors systems. Refine modeling and simulation capability to assess effectiveness of countermeasure techniques across mission concepts of employment. ***FY 2012 Base Plans:***	7.503	8.469	8.538	-	8.538

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602204F: *Aerospace Sensors*	**PROJECT** 622003: *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Continue the assessment of advanced infrared missiles and infrared acquisition sensors. Continue to develop requirements for advanced electro-optical and infrared countermeasure concepts across mission concepts of employment. Continue to develop simulation and hardware-in-the-loop test capability to evaluate and test countermeasure concepts. ***FY 2012 OCO Plans:***					
Title: Major Thrust 5. ***Description:*** Develop aerospace missile and laser warning technologies to accurately cue countermeasures. ***FY 2010 Accomplishments:*** Supported integration of new laser warning sensors with countermeasures system prototypes to provide robust capability to detect threats and cue defeat techniques. Refined sensor hardware and software design based on test data. Conducted demonstration testing of integrated capabilities. Developed new laser warning concepts to address emerging directed energy threats. ***FY 2011 Plans:*** Demonstrate integrated beam rider laser, direct tactical and indirect tactical laser detection sensors supporting proactive infrared countermeasure hand-off goals. ***FY 2012 Base Plans:*** Continue integrating advanced laser threat detection sensors to demonstrate situational awareness and countermeasure hand-off capabilities. Continue to develop new laser warning concepts to address emerging directed energy threats and develop requirements for Combat Mission Infrared Countermeasures Advanced Technology Demonstration. Continue developing tactical aerospace laser optical simulation for laser sensor characterization and countermeasure concepts. ***FY 2012 OCO Plans:***	0.449	0.727	0.550	-	0.550
Accomplishments/Planned Programs Subtotals	16.705	21.430	28.051	-	28.051

	FY 2010	FY 2011
Congressional Add: Watchkeeper	1.593	-

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 622003: *EO Sensors & Countermeasures Tech*

	FY 2010	FY 2011
FY 2010 Accomplishments: Conducted Congressionally-directed effort.		
FY 2011 Plans:		
Congressional Adds Subtotals	1.593	-

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
• Activity Not Provided: *Title Not Provided*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

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: PB 2012 Air Force			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 624916: *Electromagnetic Tech*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
624916: *Electromagnetic Tech*	18.712	18.905	-	-	-	-	-	-	-	Continuing	Continuing

Note

Note: In FY 2012 the efforts in Project 624916 move from Hanscom AFB, MA to Wright Patterson AFB, OH due to the decisions of the Base Realignment and Closure Commission. The individual efforts from Project 624916 are merged into other existing Projects in this PE.

A. Mission Description and Budget Item Justification

This project develops technologies for sensor systems that cover the electromagnetic spectrum from radio-frequency to electro-optical. It develops radio-frequency antennas and associated electronics for airborne and space-based surveillance. It also investigates radio-frequency scattering phenomenology for applications in ground and air moving target indicators in extremely cluttered environments. The project develops active and passive electro-optical sensors for use in concert with radio-frequency sensors. It develops low-cost active sensors that use reliable high-performance solid state components for target detection and identification and missile threat warning. The project also develops passive multi-dimensional sensors to improve battlefield awareness and identify threats at long-range.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Title: Major Thrust 1. ***Description:*** Investigate detection of difficult airborne and ground-based targets in clutter from airborne or space-based surveillance platforms. ***FY 2010 Accomplishments:*** Developed analytical and computationally efficient tools for multi-sensor integration for target detection, tracking, and classification in a knowledge-aided framework exploiting physics-based and data dependent electromagnetic models of targets and clutter. ***FY 2011 Plans:*** Complete development of analytical and computationally efficient tools for multi-sensor integration for target detection, tracking, and classification in a knowledge-aided framework exploiting physics-based and data dependent electromagnetic models of targets and clutter, as well as waveform diversity and dynamic sensor responses to the evolving problem solution. ***FY 2012 Base Plans:*** ***FY 2012 OCO Plans:***	3.074	3.489	-	-	-
Title: Major Thrust 2.	6.655	6.255	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 624916: *Electromagnetic Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Description: Design and develop antennas for airborne and space-based surveillance. Develop metamaterials for conformal arrays. ***FY 2010 Accomplishments:*** Developed new low-cost digital beamforming techniques for miniature remotely piloted aircraft. Integrated new detection algorithm with low cost seeker hardware. Integrated and tested new conformal digital beamforming phased array antennas on airborne radar platforms. Developed new hardware to exploit emerging metamaterials for compact radiating sensor applications including conformal array antennas and electronics based upon complex media. Assessed the viability of obtaining metamaterial properties consistent with the demonstration of highly integrated subsystems based upon radio frequency integrated circuit applications to enable small, highly directional antenna element device drivers. ***FY 2011 Plans:*** Continue integration of new detection algorithm with low cost seeker hardware. Continue integration and test of new conformal digital beamforming phased array antennas on airborne radar platforms. Continue to develop new hardware to exploit emerging metamaterials for compact radiating sensor applications including conformal array antennas and electronics based upon complex media. Continue to assess the viability of obtaining metamaterial properties consistent with the demonstration of highly integrated subsystems based upon radio frequency integrated circuit applications to enable small, highly directional antenna element device drivers. ***FY 2012 Base Plans:*** ***FY 2012 OCO Plans:***					
Title: Major Thrust 3. ***Description:*** Design and develop new electro-optical techniques and components for detecting and identifying concealed targets. ***FY 2010 Accomplishments:*** Developed new quasi-phase matched materials such as Gallium Phosphate and techniques for efficient optical sources in the mid- and long-wave infrared applications. Developed new materials systems to enable conversion from pump wavelengths between one and two microns. Tested integrated focal plane arrays. ***FY 2011 Plans:***	5.401	5.456	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 624916: *Electromagnetic Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Continue to develop new quasi-phase matched materials such as Gallium Phosphate and techniques for efficient optical sources in the mid- and long-wave infrared applications. Demonstrate new materials systems to enable conversion from pump wavelengths between one and two microns. Conclude testing of integrated focal plane arrays. ***FY 2012 Base Plans:*** ***FY 2012 OCO Plans:***					
Title: Major Thrust 4. ***Description:*** Develop hardware and software for passive multi-dimensional sensing in the thermal infrared spectral wavelength range at high frame rates. ***FY 2010 Accomplishments:*** Developed new electro-optical sensor hardware for detecting chemical, biological, radioactive, nuclear, or high explosive weapons using spectral/hyperspectral intelligence. Conducted testing to assess sensor detection and identification viability and initiated plan for transition. Developed hyperspectral and multispectral sensors and created a small, deployable instrument suitable for moving into transition with an advanced technology demonstrator. Conducted utility assessment of hyperspectral sensors for collecting data at millisecond sample rates for space-based applications. Applied spectral temporal sensor technology for cueing electro-optical and infrared persistent surveillance sensors. ***FY 2011 Plans:*** Continue development of electro-optical sensor hardware for detecting chemical, biological, radioactive, nuclear or high explosive weapons using spectral or spectral temporal intelligence. Continue development of chemical biological standoff detection hardware. Complete spectral temporal sensor demonstration for cueing electro-optical and infrared persistent surveillance sensors. ***FY 2012 Base Plans:*** ***FY 2012 OCO Plans:*** Not applicable.	3.582	3.705	-	-	-
Accomplishments/Planned Programs Subtotals	18.712	18.905	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 624916: *Electromagnetic Tech*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
• Activity Not Provided: *Title Not Provided*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

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: PB 2012 Air Force			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
626095: *Sensor Fusion Technology*	23.249	27.008	24.545	-	24.545	25.014	25.512	25.731	26.234	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops the technologies required to perform management and fusion of sensor information for timely, comprehensive situational awareness, automatic target recognition, integrated fire control, and bomb damage assessment. This project determines the feasibility of technologies and concepts for fire control that help to precisely locate, identify, and target airborne and surface targets. The project emphasizes finding reduced signature targets and targets of opportunity. It will enable new covert tactics for successful air-to-air and air-to-surface strikes. This project also develops the technologies required to create trusted autonomic, distributed, collaborative, and self-organizing sensor systems that provide anticipatory and persistent intelligence, surveillance, and reconnaissance (ISR), situational awareness, and decision support for multi-layered sensing. This program provides the technologies for: 1) trusted sensors and trusted sensor systems that will deter reverse engineering and exploitation of our critical hardware and software technology and impede unwanted technology transfer, alteration of system capability, and prevent the development of countermeasures to U.S. systems; 2) collaborative tasking of our own distributed heterogeneous sensor networks across a region and co-opted tasking of both traditional and non-traditional adversary sensors; 3) secure sensor web backbone technologies, sensor web physical topologies, and related protocols to assure reliable trusted sensor interactions; and 4) defining architectures for distributed trusted collaborative heterogeneous sensor systems and semantic sensor networks, developing new methodologies for system of systems sensor engineering and analysis, and new techniques for sensor network situation awareness and predictive analytics.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Title: Major Thrust 1.	2.127	7.261	7.529	-	7.529
Description: Develop and assess single and multi-sensor automatic target recognition (ATR) and sensor fusion algorithms for rapidly finding, tracking, and targeting mobile targets. ***FY 2010 Accomplishments:*** Assessed the image formation and processing of synthetic aperture radar, electro-optical/infrared/hyper-spectral imagery data from research and development data collections taking advantage of disparate phenomenology to improve automatic target recognition detection, classification and identification performance. Developed and validated multi-sensor/multi-frequency synthetic data generation tools required to augment and enhance collected research, development, and operational data sets. Searched out unexploited phenomenological features and initiated development of tools and technology required to exploit said features. Conducted laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Enhanced databases, tools and laboratory environments as required to support					

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
assessment and validation of models and exploitation technologies. Improved automatic target recognition performance evaluation theory for automatic target recognition technologies. ***FY 2011 Plans:*** Complete initial assessment of image formation and processing of synthetic aperture radar, electro-optical/ infrared/hyper-spectral imagery data from research and development data collections taking advantage of disparate phenomenology to improve automatic target recognition detection, classification and identification performance. Continue to develop and perform initial validation of multi-sensor/multi-frequency synthetic data generation tools required to augment and enhance collected research, development, and operational data sets. Search out unexploited phenomenological features and continue development of tools and technology required to exploit said features. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Continue enhancements to databases, tools and laboratory environments as required to support assessment and validation of models and exploitation technologies. Continue to improve automatic target recognition performance evaluation theory for automatic target recognition technologies. ***FY 2012 Base Plans:*** Build upon initial assessment of image formation and processing of synthetic aperture radar, electro-optical/ infrared/hyper-spectral imagery data from research and development data collections to develop the theories and basic techniques needed to create a three dimensional, time independent, large area automated and/or assisted exploitation capability. Continue to develop technologies requiring further research in areas discovered previously during initial validation of multi-sensor/multi-frequency synthetic data generation tools required to augment and enhance collected research, development, and operational data sets. Continue to search out unexploited phenomenological features and continue development of tools and technology required to exploit said features. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Assess state of the art in databases, tools and laboratory environments supporting ATR technology development and research those areas discovered as lacking in sufficient capability required to support assessment and validation of models and exploitation technologies. Continue to assess and improve automatic target recognition performance evaluation theory for automatic target recognition technologies. ***FY 2012 OCO Plans:***					
Title: Major Thrust 2.	5.097	6.250	5.043	-	5.043

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Description: Develop, evaluate, and demonstrate target signature models to support ATR and sensor fusion algorithm development and testing for reconnaissance and strike mission applications. ***FY 2010 Accomplishments:*** Matured target signature models for signature exploitation of radio-frequency sensors, electro-optical multi-spectral systems, and signals intelligence sensors emphasizing one target model for application to all parts of the spectrum. Developed signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology automatic target recognition of ground targets. Developed signatures, algorithms, target modeling and modeling of other phenomenological features that heretofore have not been exploited. Generated synthetic air and ground target signatures with sufficient fidelity to support development and assessment of automatic recognition of targets in operationally realistic mission environments. Demonstrated large area, reconnaissance coverage, synthetic scene data generation capability for radio-frequency and electro-optical sensors. Investigated model-driven spectral signal processing and exploitation techniques. ***FY 2011 Plans:*** Complete initial target signature models for signature exploitation of radio-frequency sensors, electro-optical multi-spectral systems, and signals intelligence sensors emphasizing one target model for application to all parts of the spectrum. Continue to develop signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology automatic target recognition of ground targets. Continue the development of signatures, algorithms, target modeling, and modeling of other phenomenological features not previously exploited. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support development and assessment of automatic recognition of targets in operationally realistic mission environments. Continue investigation of model-driven spectral signal processing and exploitation techniques. Continue development of automatic target recognition algorithm-driven radio-frequency sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data. ***FY 2012 Base Plans:*** Assess the state of the art to determine remaining technology shortfalls and develop signatures, algorithms, and modeling support for multiple radio-frequency and electro-optical phenomenology automatic target recognition of ground targets addressing those technology needs. Continue the development of signatures, algorithms, target modeling, and modeling of other phenomenological features not previously exploited. Assess current technology capability and with predicted fidelity requirements to meet anticipated mission requirements and					

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
continue to generate synthetic air and ground target signatures and supporting technologies sufficient to meet those needs.. Continue investigation of model-driven spectral signal processing and exploitation techniques. Continue development of automatic target recognition algorithm-driven radio-frequency sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high-diversity data. ***FY 2012 OCO Plans:***					
Title: Major Thrust 3. ***Description:*** Develop ATR, sensor management, and sensor fusion technologies for target detection, tracking, and identification in ISR and combat identification applications. ***FY 2010 Accomplishments:*** Demonstrated and assessed fusion capability for radar, electro-optical/infrared, laser detection and ranging, and hyperspectral features for target detection, tracking, and identification with sensor management techniques. Enhanced physics-based techniques to meet the target detection and identification requirements for intelligence, surveillance, and reconnaissance and combat identification applications. Developed and evaluated automated battle space behavior analysis. Developed and assessed technology that will fuse precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Enhanced multi-sensor, pixel level registration techniques as necessary to support requirements. Assessed and developed capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Conducted research of bio-inspired automatic target recognition technologies and assessed and evaluated these techniques for all missions with emphasis on urban applications. ***FY 2011 Plans:*** Enhance and assess physics-based techniques to meet the target detection and identification requirements for intelligence, surveillance, and reconnaissance and combat identification applications. Continue development and evaluation of automated battle space behavior analysis. Continue development and assessment of technology that will fuse precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Enhance multi-sensor, pixel level registration techniques as necessary to support requirements. Continue to assess and develop capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Continue	2.045	2.290	1.385	-	1.385

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
research of bio-inspired automatic target recognition technologies and continue to assess and evaluate these techniques for all missions with emphasis on urban applications. ***FY 2012 Base Plans:*** Build upon initial assessment of image formation and processing of synthetic aperture radar, electro-optical/ infrared/hyper-spectral imagery data from research and development data collections to develop the theories and basic techniques needed to create a three dimensional, time independent, large area automated and/or assisted exploitation capability. Continue to develop technologies requiring further research in areas discovered previously during initial validation of multi-sensor/multi-frequency synthetic data generation tools required to augment and enhance collected research, development, and operational data sets. Continue to search out unexploited phenomenological features and continue development of tools and technology required to exploit said features. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Assess state of the art in databases, tools and laboratory environments supporting ATR technology development and research those areas discovered as lacking in sufficient capability required to support assessment and validation of models and exploitation technologies. Continue to assess and improve automatic target recognition performance evaluation theory for automatic target recognition technologies. ***FY 2012 OCO Plans:***					
Title: Major Thrust 4. ***Description:*** Develop technical methods required for algorithm performance models, ATR driven sensing, layered sensing and other sensing and exploitation technologies impacted by ATR capabilities. ***FY 2010 Accomplishments:*** Evaluated new innovations in automatic target recognition-related technologies. Developed fundamental automatic target recognition approaches for subcomponents. Began development of a capability to model the performance of these technologies. Determined methods of performance modeling validation. Developed databases and tools required to support performance modeling and assessment. Developed an integrated, unified automatic target recognition methodology building upon the modeling and assessment tools developed. ***FY 2011 Plans:***	1.557	5.638	6.325	-	6.325

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Continue investigations of sensor exploitation techniques. Continue development of a capability to model the performance of these technologies. Initiate validation of algorithm performance models. Continue development of databases and tools required to support performance modeling and assessment. Continue and enhance development of an integrated, unified automatic target recognition methodology building upon the modeling and assessment tools developed. ***FY 2012 Base Plans:*** Continue investigations of sensor exploitation techniques. Continue development of a capability to model the performance of these technologies. Validate algorithm performance models and determine capability shortfalls. Continue development of databases and tools required to support performance modeling and assessment. Continue and enhance development of an integrated, unified automatic target recognition methodology building upon the modeling and assessment tools developed. ***FY 2012 OCO Plans:***					
Title: Major Thrust 5. ***Description:*** Develop, evaluate, and demonstrate methodologies, techniques, and strategies to instill trust in distributed, heterogeneous sensing systems within air, space, and cyber domains. ***FY 2010 Accomplishments:*** Completed development of new techniques for systems sensor engineering and analysis. Completed development of new techniques for sensor network situational awareness and global measures of trust for multi-layered sensing. Completed development of representative measures of system trustworthiness for collaborative and distributed heterogeneous sensing system architectures and semantic sensor networks. Developed new technologies and methodologies for producing adaptive, trusted architectures for multi-layered sensing. ***FY 2011 Plans:*** Complete development of new technologies and methodologies for producing adaptive, trusted architectures for multi-layered sensing. Initiate development of advanced trusted sensor web services, middleware, and frameworks for multi-layered sensing and cyber sensing. Initiate development of methodologies and techniques for visualization and portrayal of a global trust picture. Initiate development of technologies for assessing, evaluating, and managing trust at a distance in distributed heterogeneous sensor systems. ***FY 2012 Base Plans:***	5.064	2.496	1.694	-	1.694

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Continue development of advanced trusted sensor web services, middleware, and frameworks for multi-layered sensing and cyber sensing. Continue development of methodologies and techniques for visualization and portrayal of a global trust picture. Continue development of technologies for assessing, evaluating, and managing trust in distributed heterogeneous sensor systems. Continue development of methods, tools, and processes to determine and assess vulnerability as a function of system scale in complex system-of-systems. ***FY 2012 OCO Plans:***					
Title: Major Thrust 6. ***Description:*** Develop technologies that enable autonomic trusted features in sensor systems to deter reverse engineering and exploitation of critical military hardware and software systems. ***FY 2010 Accomplishments:*** Developed and demonstrated critical technologies for trusted sensors for multi-layered ISR sensing systems to assure anti-tamper and software protection of key military capabilities. Assessed and evaluated commercial technologies for application to military trusted systems. Developed and demonstrated secure cyber sensing station for ISR and cyberspace applications. Initiated development of autonomic trusted sensor technologies to address self-ware, self-healing, and self-organizing sensor systems. ***FY 2011 Plans:*** Continue to develop key technologies for trusted sensors for multi-layered ISR sensing systems to assure anti-tamper and software protection of key military capabilities. Continue to assess and evaluate commercial technologies for application to military trusted systems. Continue development of autonomic trusted sensor technologies to address self-ware, self-healing, and self-organizing sensor systems. Initiate development of integrated anti-tamper and software protection solutions. Initiate development of key technology experiments to test and demonstrate trusted sensor technologies on military weapon systems. ***FY 2012 Base Plans:*** Develop fully integrated software protection and anti-tamper systems for multi-layered ISR sensing systems and cyberspace applications. Develop software protections that incorporate adversarial reasoning and cognitive deception as part of a layered cyber defense. Develop detect and response mechanism to remedy software and hardware supply chain vulnerabilities. Develop software protections that allow system protection, survivability	1.162	1.429	1.332	-	1.332

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
and mission operations during an attack. Develop software protection and anti-tamper solutions that integrate universal situational awareness to improve attack monitoring and prediction capabilities. ***FY 2012 OCO Plans:***					
Title: Major Thrust 7. ***Description:*** Develop secure backplane, integration technology, physical topologies, and protocols to support multi-layered sensing and trusted sensor networks for air, space, and cyber domains. ***FY 2010 Accomplishments:*** Completed conceptual design of sensor web backbone technology to assure trusted sensor interactions for multi-layered persistent ISR sensing. Developed sensor web backbone integration laboratory. Completed initial assessment of available sensor technologies for trusted sensing. Initiated development of advanced sensor bus technologies for trusted sensing. Initiated analysis to exploit wired and wireless sensor web systems. ***FY 2011 Plans:*** Continue demonstration of laboratory prototype of sensor web backbone and physical topologies. Continue development of advanced sensor bus technologies for trusted sensing. Continue analysis to exploit wired and wireless senor web systems and begin analysis of technologies to defend sensor web systems. Complete development of the sensor web backbone integration laboratory. ***FY 2012 Base Plans:*** Continue demonstration of laboratory prototype of sensor web backbone and physical topologies. Continue development of advanced sensor bus technologies for trusted sensing. Continue analysis to exploit wired and wireless sensor web systems and begin analysis of technologies to defend sensor web systems. Expand applicability of the sensor web backbone integration laboratory to various avionic systems. ***FY 2012 OCO Plans:***	2.373	1.644	1.237	-	1.237
Accomplishments/Planned Programs Subtotals	19.425	27.008	24.545	-	24.545

	FY 2010	FY 2011
Congressional Add: Information Quality Tools for Persistent Surveillance Data Sets.	1.434	-

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 626095: *Sensor Fusion Technology*

	FY 2010	FY 2011
FY 2010 Accomplishments: Conducted Congressionally-directed effort. ***FY 2011 Plans:***		
Congressional Add: Net-centric Sensor Grids. ***FY 2010 Accomplishments:*** Conducted Congressionally-directed effort. ***FY 2011 Plans:***	2.390	-
Congressional Adds Subtotals	3.824	-

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
• Activity Not Provided: *Title Not Provided*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

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: PB 2012 Air Force			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
627622: *RF Sensors & Countermeasures Tech*	35.772	55.696	39.319	-	39.319	39.459	35.751	36.315	37.046	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and assesses affordable, reliable all weather radio-frequency sensing and countermeasure concepts for aerospace applications covering the range of radio frequency sensors including communications, navigation, intelligence, surveillance, reconnaissance, and radar, both active and passive, across the air, land, sea, space and cyber domains. This project also develops and evaluates technology for intelligence, surveillance, and reconnaissance sensors, fire control radars, electronic warfare, integrated radar and electronic warfare systems, and offensive information operations systems. It emphasizes the detection and tracking of surface and airborne targets with radio-frequency signatures that are difficult to detect due to reduced radar cross sections, concealment and camouflage measures, severe clutter, or heavy jamming. Techniques exploited include the use of multiple radio-frequency phenomenologies, multi dimensional adaptive processing, advanced waveforms and knowledge-aided processing techniques. This project also develops the radio-frequency warning and countermeasure technology for advanced electronic warfare and information operations applications. Specifically, it develops techniques and technologies to detect and counter the communications links and sensors of threat air defense systems and hostile command and control networks. The project also exploits emerging technologies and components to provide increased capability for offensive and defensive radio-frequency sensors, including radar warning, radio-frequency electronic warfare, and electronic intelligence applications.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Title: Major Thrust 1.	5.357	8.827	8.662	-	8.662
Description: Develop technology to reduce size, weight, and power of radio frequency (RF) sensors. Develop technology to enable affordable upgrades and optimally control RF and multi-intelligence sensors.					
FY 2010 Accomplishments: Demonstrated advanced RF receiver hardware and digital receiver/techniques generators technologies. Initiated new effort for the development of an adaptable (cognitive) electronic support (ES) and/or electronic attack (EA) capability.					
FY 2011 Plans: Continue the research and exploration of an adaptable ES/EA capability, including exploration of the synergy of real-time ES coupled with tailorable EA techniques.					
FY 2012 Base Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Initiate research and modeling of layered electronic warfare (EW) effects (i.e., multiple jammers or jamming techniques). Explore and analyze a future/on-coming RF-based threat for potential counters and perform initial vulnerability assessment. Research advanced ES concepts. ***FY 2012 OCO Plans:***					
Title: Major Thrust 2. ***Description:*** Develop robust, ultra-wide bandwidth aerospace electronic aperture technologies and next generation applied radio-frequency aperture technology for manned and unmanned platforms. ***FY 2010 Accomplishments:*** Completed design and development of multi-function thin-profile array with integrated receiver and exciter. ***FY 2011 Plans:*** ***FY 2012 Base Plans:*** ***FY 2012 OCO Plans:***	4.858	-	-	-	-
Title: Major Thrust 3. ***Description:*** Develop RF sensing and electronic warfare/information operations concepts and technologies for concurrent multi-mode operation and digital beam forming. ***FY 2010 Accomplishments:*** Designed and developed highly digital electronically scanned array with transmit and receive capabilities for multi-mode radio frequency sensing. Developed integrated receiver/exciter and digital beamforming concepts to support wideband multiple intelligence (multi-INT) sensing systems including modeling and simulation capability, critical components, algorithms, and subsystem architectures. ***FY 2011 Plans:*** Continue development of highly digital electronically scanned array. Design and develop an integrated receiver, exciter and digital beamforming subsystem to support wideband multi-INT sensing systems. Characterize and assess emerging over-the-horizon (OTH) radar technologies using modeling and simulation, experimentation,	2.772	15.302	4.169	-	4.169

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
and demonstrations. Identify further research and development needed to advance the state-of-the-art in OTH radar. ***FY 2012 Base Plans:*** Demonstrate prototype elements for highly digital electronically scanned array. Continue to design and develop an integrated receiver, exciter and digital beamforming subsystem to support wideband multi-INT sensing systems. ***FY 2012 OCO Plans:***					
Title: Major Thrust 4. ***Description:*** Develop waveforms using transmit adaptivity and multi-mode operation, and multi-platform, multi-mission sensor and EW adaptive processing algorithms to improve sensor performance. ***FY 2010 Accomplishments:*** Investigated and evaluated waveform diversity techniques and multiple-input/multiple-output adaptive processing algorithms to improve electronic protection functions in conventional and advanced radio-frequency systems. Developed distributed signal processing techniques to obtain high spatial resolution with limited transmit bandwidth, and to detect challenging targets such as those with low radar cross-section. ***FY 2011 Plans:*** Develop new electronic protection techniques exploiting waveform diversity techniques and multiple-input/multiple-output adaptive processing algorithms. Develop operationally relevant approaches to the employment of distributed signal processing techniques to obtain high spatial resolution with limited transmit bandwidth, and to detect challenging targets such as those with low radar cross-section. Characterize and assess emerging over-the-horizon (OTH) radar technologies using modeling and simulation, experimentation, and demonstrations. Identify further research and development needed to advance the state-of-the-art in OTH radar. ***FY 2012 Base Plans:*** Continue to develop radar electronic protection techniques based upon technical advances in waveform diversity, multiple inputs, multiple outputs (MIMO) array configurations, and multi-channel adaptive processing. Demonstrate the use of RF tomography to create imagery and detect movers in a complex spectral environment. Continue modeling simulation, experimentation, and demonstrations of advanced technologies to field over	14.574	22.423	17.650	-	17.650

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
horizon radar technologies. Build and test a prototype OTH radar to evaluate candidate technologies to include MIMO and adaptive processing to improve our understanding of ionosphere phenomenology. ***FY 2012 OCO Plans:***					
Title: Major Thrust 5. ***Description:*** Develop hybrid space-based sensor solutions to be responsive to space needs and detect difficult targets. Develop jam-resistant space-qualified time, position, and velocity sensors. ***FY 2010 Accomplishments:*** Investigated optimal means of tightly coupling networked sensing platforms with their reference systems by leveraging onboard sensors observations as feedback to robustly calibrate the distributed, multi-platform reference. Conducted ground-based demonstration of modular payload building blocks compatible with operationally responsive space rapid integration requirements. ***FY 2011 Plans:*** Continue to investigate optimal means of tightly coupling networked sensing platforms with their reference systems by leveraging onboard sensor observations as feedback to robustly calibrate the distributed, multi-platform reference. Demonstrate tightly coupled reference system technology both non-real-time and real time. ***FY 2012 Base Plans:*** Develop strategies to optimize reference technologies for distributed sensing missions. Explore alternatives when GPS is degraded or denied. Reduce size, weight, and power of inertial components. Enhance precision of GPS and non-GPS reference technologies. ***FY 2012 OCO Plans:***	5.221	4.103	4.931	-	4.931
Title: Major Thrust 6. ***Description:*** Study adaptive processing techniques for large, multi-mission, space-based conformal arrays to meet the demands of wide area sensing in severe clutter and interference environments. ***FY 2010 Accomplishments:***	1.718	0.821	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602204F: *Aerospace Sensors*	PROJECT 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Evaluated advanced surface moving target indication algorithms and computing architectures for high altitude, environmentally constrained radio frequency sensing system applications. Evaluated emissions mapping and bistatic radar techniques for providing space situational awareness. ***FY 2011 Plans:*** Demonstrate an integrated radio frequency and electro-optical modeling and simulation toolset for an advanced space situational awareness architecture. Develop electronic protection (EP) techniques for space-based sensors, exploiting waveform diversity techniques and multiple-input/multiple-output adaptive processing algorithms. ***FY 2012 Base Plans:*** ***FY 2012 OCO Plans:***					
Title: Major Thrust 7. ***Description:*** Develop multi-band and multi-beam forming technologies. Address technologies for antenna array operations in dynamic sensor networks. ***FY 2010 Accomplishments:*** Demonstrated a responsive space payload. ***FY 2011 Plans:*** Develop an electronic chassis framework (toolkit) for applying Open Architectures (OA) to DOD sensing systems. Develop W-band solid state power amplifier for wideband SATCOM applications. ***FY 2012 Base Plans:*** Further develop an electronic chassis framework (toolkit) for applying Open Architectures (OA) to DOD sensing systems. Further develop and demonstrate a W-band solid state power amplifier for wideband SATCOM applications. ***FY 2012 OCO Plans:***	0.160	1.902	3.907	-	3.907
Title: Major Thrust 8. ***Description:*** Develop sensor techniques to achieve highly accurate and robust navigation performance for hypersonic air vehicles in prompt global strike applications.	1.112	2.318	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2012 Air Force		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 3600: *Research, Development, Test & Evaluation, Air Force* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602204F: *Aerospace Sensors*	**PROJECT** 627622: *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
FY 2010 Accomplishments: Designed a radio-frequency hardware-in-the-loop testbed to implement hypersonic air vehicle plasma characteristics, platform trajectories, and highly accurate and robust navigation techniques for space-based applications. Demonstrated a constructive systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility. ***FY 2011 Plans:*** Complete the design of a radio-frequency hardware-in-the-loop testbed to implement hypersonic air vehicle plasma characteristics, platform trajectories, and highly accurate and robust navigation techniques for space-based applications. Continue to demonstrate a constructive systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility. ***FY 2012 Base Plans:*** ***FY 2012 OCO Plans:***					
Accomplishments/Planned Programs Subtotals	35.772	55.696	39.319	-	39.319

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
• Activity Not Provided: *Title Not Provided*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

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.