PE NUMBER: 0602204F
PE TITLE: Aerospace Sensors

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2007

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Sensors

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	114.934	133.235	108.055	103.739	112.113	113.144	110.852	113.264	Continuing	TBD
2002	Electronic Component Technology	22.442	28.198	25.090	22.458	21.179	20.539	21.004	21.393	Continuing	TBD
2003	EO Sensors & Countermeasures Tech	22.141	22.111	16.077	16.346	16.400	16.567	16.914	17.299	Continuing	TBD
44SP	Space Sensors	0.000	8.848	10.244	8.948	10.556	10.477	10.541	10.775	Continuing	TBD
4916	Electromagnetic Tech	17.746	21.252	12.513	11.808	11.625	12.178	12.449	12.751	Continuing	TBD
6095	Sensor Fusion Technology	16.754	18.578	18.335	18.118	18.109	18.295	18.643	19.030	Continuing	TBD
7622	RF Sensors & Countermeasures Tech	35.851	34.248	25.796	26.061	34.244	35.088	31.301	32.016	Continuing	TBD

Note: In FY 2006, efforts in Project 5016 transferred to Project 2002 within this PE. Also in FY 2006, efforts in Project 5017 transferred to Project 7622 within this PE. In FY 2007, Project 44SP, Space Sensors, efforts will transfer from PE 0602500F, Multidisciplinary Space Technology, Project 5028, Space Sensors, Photonics and RF Processors, and Project 5029, Space Sensor and CM Technology, in order to more effectively manage and provide oversight of the efforts.

(U) 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) RF 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 RF sensors and electronic combat systems. Note: In FY2007, Congress added $1.4 million for 3-D Packaging Technology for High Speed RF Communications; $1.0 million for Phased Array Antenna Control Computer; $1.6 million for the Center for Advanced Sensor and Communication Antennas; $1.7 million for the Super-Resolution Sensor System; $2.0 million for Compact, Ultra-sensitive Optical Receiver for Smart and Loitering Standoff Weapons; $1.1 million for Advanced Sensor Aided Vigilance Technologies; $2.0 million for Optically Pumped Atomic Laser; $1.0 million for Hanscom AFB Collaboration on Meta-Materials and Conformal Antenna Technologies; $2.0 million for WBI LADAR Development and Demonstration; $1.4 million for Wideband Digital Airborne Electronic Sensing Array; and $1.0 million for Sensor Network Technology. 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	DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors

(U) B. Program Change Summary ($ in Millions)

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	115.689	117.553	105.531	109.491
(U)	Current PBR/President's Budget	114.934	133.235	108.055	103.739
(U)	Total Adjustments	-0.755			
(U)	Congressional Program Reductions		-0.012		
	Congressional Rescissions	-0.006	-0.506		
	Congressional Increases		16.200		
	Reprogrammings	0.497			
	SBIR/STTR Transfer	-1.246			

(U) Significant Program Changes:

Not Applicable.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE: 2002 Electronic Component Technology	

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2002 Electronic Component Technology	22.442	28.198	25.090	22.458	21.179	20.539	21.004	21.393	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2006, efforts in Project 5016 transferred to this project in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project focuses on generating, controlling, receiving, and processing electronic signals for radio frequency (RF) sensor aerospace applications. The enabling technologies developed under this project will be used for intelligence, surveillance, reconnaissance (ISR), electronic warfare (EW), 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, EW, navigation, and smart weapons.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop compact, affordable, multi-function receiver/exciter and phased array components for communications, Global Positioning System, radar, EW, and ISR sensors. Develop advanced aperture subsystems that support affordable and scalable antenna arrays, as well as enable efficient wideband, multi-function sensors for radar, EW, and communications. Develop receiver and exciter subsystem technologies that enable compact, affordable, multi-function, multi-beam radar and EW systems.	5.408	8.466	6.962	7.566

(U) In FY 2006: Demonstrated low cost, lightweight subpanel for phased array radar applications. Demonstrated an affordable, compact receiver-on-a-chip by leveraging advances in commercial Silicon Germanium (SiGe) technology for multifunction and reconfigurable sensor systems.

(U) In FY 2007: Develop scalable panel demonstration with multiple panel communication and metrology. Design and demonstrate a distributed receiver/exciter architecture for advanced multifunction systems used in radar and EW sensors for ISR and battlespace access capabilities.

(U) In FY 2008: Develop integrated wideband multi-channel phased array subarray with digital receiver/exciter architecture for future multi-intelligence EW/radar applications. Complete demonstration of distributed receiver/architecture for advanced multi-function systems used in radar and

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2002 Electronic Component Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	EW sensors.				
(U)	In FY 2009: Demonstrate integrated wideband subarray for future multi-intelligence EW/radar applications. Design and develop digital/receiver components to enable full digital receiver/exciter capability per transmit/receive (T/R) site to enable future software controlled phased arrays.				
(U)					
(U)	MAJOR THRUST: Develop new microelectronic component technologies for radar, EW, and communications to support ISR, precision strike and battlespace access capabilities using advances in material research and microelectronic fabrication techniques.	1.119	4.214	3.758	3.418
(U)	In FY 2006: Developed engineering model of advanced photonic modulation components for low loss signal distribution.				
(U)	In FY 2007: Demonstrate integrated photonic microsystems. Develop electronics modeling and assessment techniques. Develop high performance radio frequency (RF) circuits on lightweight and flexible substrates using advanced semiconducting materials and devices.				
(U)	In FY 2008: Fabricate and perform lab testing to investigate physical and chemical properties of microcircuits under operating conditions to understand operating lifetime limiting changes in structure. Continue development of electronics modeling and assessment techniques. Develop flexible and transparent RF electronics.				
(U)	In FY 2009: Continue fabrication and lab testing to investigate physical and chemical properties of microelectronics to develop models to predict failure modes and lifetimes. Further refine electronics modeling and assessment techniques. Demonstrate flexible and RF transparent electronics.				
(U)					
(U)	MAJOR THRUST: Develop integration and assembly technologies for high performance aerospace phased array sensors. Design and model photonic component technologies for RF distribution and signal processing. Develop Electro-Optical (EO) devices for next generation warfighter applications.	2.824	4.367	6.224	3.266
(U)	In FY 2006: Designed and fabricated advanced components for external and direct modulation of optical sources with high efficiency for RF photonic links used in radar and communications. Demonstrated optical modulation technology with high linearity and dynamic range for ISR, battlespace access, and time-sensitive targeting capabilities.				
(U)	In FY 2007: Design and develop RF modulation components to enable low loss wideband RF links and arbitrary EO waveform generation. Initiate development of veritcal, external cavity, surface emitting lasers (VECSEL) as compact, efficient, high-nrightness sources. Initiate development of fiber optics and				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2002 Electronic Component Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	optical components for high power mid-infrared (IR) applications.				
(U)	In FY 2008: Demonstrate photonic RF modulation components for RF links and arbitrary EO waveform generation. Continue development of VECSELs as compact, efficient, high-brightness sources. Continue development of fiber optics and optical components for high power mid-IR applications.				
(U)	In FY 2009: Further develop VECSELs as compact, efficient, high-brightness sources. Complete development of fiber optics and optical components for high power mid-IR applications.				
(U)					
(U)	MAJOR THRUST: Develop signal control and low-power consumption components and techniques to reduce both power loss and power consumption for future radar, electronic warfare, and ISR sensors. Develop and integrate adaptable circuit technologies which utilize dynamic elements and low loss signal control for multi-function radar and EW sensors used for ISR and battlespace access capabilities. Develop wideband (multi-octave) component technologies for multi-function RF apertures used in radar and EW sensor systems.	6.463	5.262	5.924	5.968
(U)	In FY 2006: Designed, implemented, and characterized low insertion loss tunable filters for advanced RF multifunction front ends. Demonstrated RF transistors with five-fold reduction in parasitic capacitance for equivalent power output. Designed and demonstrated Gallium Nitride (GaN) based field-effect devices with enhanced power handling capabilities.				
(U)	In FY 2007: Develop and demonstrate adaptable microcircuits for multi-function applications. Characterize and transition reliable wideband power amplifiers for multifunction radar and EW sensor applications. Complete characterization of high reliability GaN based circuits for millimeter wave and Q-band applications.				
(U)	In FY 2008: Develop and demonstrate adaptable microcircuits for multi-function sensors.				
(U)	In FY 2009: Develop tunable and reconfigurable wideband amplifiers for use in multi-function radar and EW sensors.				
(U)					
(U)	MAJOR THRUST: Refine materials and processes for two-dimensional and three-dimensional device interconnects and component protection from the environment. Develop and demonstrate innovative RF component technology that lowers system cost through reduction of design costs, part count, chip size, production costs, and integration costs.	0.968	2.207	1.119	1.122
(U)	In FY 2006: Developed advanced component characterization techniques to assess and mitigate failures in emerging semiconductor technologies and to develop predictive failure models.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2002 Electronic Component Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2007: Design and implement military specific RF components using advanced circuit design techniques and latest commercial foundry advances. Characterize and perform trade-space analysis with respect to traditional RF component technologies.				
(U)	In FY 2008: Investigate microcircuit integration modeling and simulation tools to enable two-dimensional and three-dimensional electronics.				
(U)	In FY 2009: Develop and demonstrate highly integrated phase control components for use in wideband multi-function sensors.				
(U)					
(U)	MAJOR THRUST: Evaluate the integrated tool suite in the modeling, simulation, design, and characterization environment for mixed-signal (digital, RF, microwave, etc.) component development in both advanced and emerging electronic component technologies.	3.710	2.287	1.103	1.118
(U)	In FY 2006: Modeled and transitioned electrostatic adaptable microsystems for dense signal environments.				
(U)	In FY 2007: Design and initial modeling of next generation wideband gap devices for high power, high temperature, and broadband multi-function systems.				
(U)	In FY 2008: Continue design and refinement of models for next generation high-power components that operate under extreme conditions and enable multi-function sensors.				
(U)	In FY 2009: Demonstrate models and designs through the characterization of high-power components for use in extreme environments with wideband and multi-function capability.				
(U)					
(U)	CONGRESSIONAL ADD: 3-D Packaging Technology for High Speed RF Communications.	1.950	1.395	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for 3-D Packaging Technology for High Speed RF Communications.				
(U)	In FY 2007: Conduct Congressionally-directed effort for 3-D Packaging Technology for High Speed RF Communications.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	22.442	28.198	25.090	22.458

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2002 Electronic Component Technology

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602500F, Multi-Disciplinary Space Technology.										
(U) PE 0603203F, Advanced Aerospace Sensors.										
(U) PE 0603270F, Electronic Combat Technology.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE: 2003 EO Sensors & Countermeasures Tech	

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2003 EO Sensors & Countermeasures Tech	22.141	22.111	16.077	16.346	16.400	16.567	16.914	17.299	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project determines the technical feasibility of advanced electro-optical (EO) aerospace sensor technologies for a variety of offensive and defensive uses. The sensor technologies under development range from the ultraviolet through the infrared (IR) 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 EO 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 hyperspectral 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 EO threat warning and countermeasures.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop technology for non-cooperative detection and identification of airborne and ground-based targets.	1.862	2.795	2.858	2.978

(U) In FY 2006: Expanded ground- and air-based testing and demonstration of advanced combat identification (CID) systems with multi-spectral, polarization-based detection and cueing and active EO combat identification sensors to include 3-D imaging. Developed hybrid focal planes and read-out electronics capable of simultaneous multi-discriminant sensing. Completed EO/IR system architectures for layered sensing based on multiple platform types for deep penetration and continuous area coverage.

(U) In FY 2007: Perform off-board cued ground- and air-based testing and demonstration of advanced CID systems with multi-spectral, polarization-based target re-acquisition and active EO interrogation for combat identification including 3-D imaging and vibration sensing. Continue development of hybrid focal planes and read-out electronics capable of simultaneous multi-discriminant sensing. Begin demonstration of EO/IR system architectures for layered sensing based on multiple platform types for deep penetration and continuous area coverage.

(U) In FY 2008: Perform phenomenology experiments for multi-discriminant active/passive sensing and perform sensor concept modeling. Collect signature data for target discrimination and shape extraction using passive multispectral/polarimetric sensing techniques. Characterize the performance of a longwave hyperspectral sensor for performing identification of gaseous targets. Demonstrate hybrid focal planes and read-out electronics for simultaneous multi-discriminant active/passive sensing, and develop image processing techniques for sensor data enhancement.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2003 EO Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2009: Perform sensor concept demonstrations for multi-discriminant active/passive sensing and quantify expected system performance. Characterize target discrimination and shape extraction performance using passive multispectral/polarimetric sensing techniques. Continue demonstration of hybrid focal planes and read-out electronics for simultaneous multi-discriminant active/passive sensing, and refine image processing techniques for sensor data enhancement. Perform trade-off studies for long range target identification using passive and active techniques, including polarimetric discrimination and synthetic aperture laser radar.				
(U)					
(U)	MAJOR THRUST: Develop optical transmitter technology capable of sensing multiple target characteristics for robust non-cooperative target identification.	3.051	7.384	5.973	6.561
(U)	In FY 2006: Tested optical transmitter technologies capable of sensing multiple target characteristics for robust non-cooperative target identification. Developed adaptable waveforms for multi-discriminant sensing. Conducted laboratory and field tests and utility analysis of multi-function pulsed vibration/imaging sensing system and evaluated performance for long range CID. Performed initial flights for pulsed gated imager and vibration CID sensor. Tested breadboard active multi-spectral transmitter and evaluated performance for both hard and extended targets. Conducted flight capable, long-range, multi-function brassboard sensor development. Utilized flight test platform to support testing of long-range air-to-air and air-to-ground systems under development. Collected simultaneous passive and multi-function active sensing phenomenology data in airborne environment for difficult target detection analysis including diverse background characterization.				
(U)	In FY 2007: Continue development and testing of optical transmitter technologies including waveforms capable of sensing multiple target characteristics for robust non-cooperative target identification. Continue laboratory and field tests and utility analysis of multi-function pulsed vibration/imaging sensing system and evaluate performance for long-range CID. Perform flight data collections for pulsed gated imager and vibration CID sensor. Complete testing of breadboard active multi-spectral transmitter and evaluate performance for both hard and extended targets. Continue flight capable, long-range, multi-function engineering model sensor development. Utilize flight test platform to support testing of long-range air-to-air and air-to-ground systems under development. Continue collection of simultaneous passive and multifunction active sensing phenomenology data in airborne environment for difficult target detection analysis including diverse background characterization.				
(U)	In FY 2008: Extend development and testing of optical transmitter technologies for non-cooperative				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2003 EO Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	target identification to increased standoff ranges. Explore optical discriminants for long range identification including shape, polarization, and vibration using real-beam and synthetic aperture sensing techniques. Develop advanced models to support phenomenology-driven sensor trade studies with both active and passive sensors. Perform tower and flight collections to validate system modeling results. Explore enabling sensor components to support extended range operation.				
(U)	In FY 2009: Continue development and testing of optical transmitter technologies for non-cooperative target identification at long standoff ranges. Perform multi-function signature collections for long range identification including shape, polarization, and vibration using real-beam and synthetic aperture sensing techniques. Develop optimal system concepts using advanced active and passive sensor models. Continue tower and flight collections to quantify expected performance. Develop enabling sensor components for a long range demonstration system.				
(U)					
(U)	MAJOR THRUST: Develop innovative techniques and components to target difficult objects in battlefield environments.	4.782	3.561	3.660	3.807
(U)	In FY 2006: Developed techniques and components to target difficult objects in degraded atmospheric conditions. Integrated and evaluated weather/obscurant penetration concepts. Evaluated utility of non-mechanical beam steering concepts for advanced multi-mode sensor applications including precision pointing, focusing, and wavefront correction and extended to common EO/radio frequency (RF) aperture implementation. Developed and demonstrated combined EO/RF aperture including preliminary sensor configuration. Continued tests, analysis, and evaluation of specialized multi-function laser radar (LADAR) for detection and characterization of difficult targets. Completed optimized architecture definition for advanced EO unmanned aerial vehicle (UAV) based systems to find, fix, and identify difficult targets in difficult environments including the urban environment. Incorporated advanced passive and multi-function active sensing methods to exploit all salient target and background phenomenologies. Performed target phenomenology investigations.				
(U)	In FY 2007: Continue development and begin demonstration of techniques and components to target difficult objects in degraded atmospheric conditions. Integrate and evaluate weather/obscurant penetration concepts into system level tests. Demonstrate utility of non-mechanical beam steering for advanced multi-mode sensor applications, including precision pointing, focusing, and wavefront correction. Continue development and demonstrations of combined EO/RF apertures including preliminary sensor configuration. Continue analysis and evaluation of specialized multi-function 3-D				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2003 EO Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	LADAR for detection and characterization of difficult targets. Explore implementation of advanced architectures for advanced EO UAV-based systems to find, fix, and identify difficult targets in challenging environments including the urban environment. Incorporate advanced passive and multifunction active sensing methods to exploit all salient target and background phenomenologies. Continue target phenomenology investigations.				
(U)	In FY 2008: Extend development of techniques for targeting difficult objects in dynamic urban environments. Develop passive infrared components and techniques for continuous surveillance of broad areas with detection/tracking of dynamic targets and events. Continue development of non-mechanical beamsteering for both passive and active sensors. Explore passive and active LADAR sensing phenomenology techniques for capturing robust spectral, spatial, polarimetric, and radiometric signatures for moving target identification and track association in dense target areas.				
(U)	In FY 2009: Continue development of techniques for targeting difficult objects in dynamic urban environments. Perform concept demonstrations of passive infrared continuous surveillance of broad areas with detection/tracking of dynamic targets and events. Develop sensor concept designs for optimizing revisit rate and perform design trade-off experiments. Perform spectral, spatial, polarimetric, and radiometric signature collection experiments using laboratory passive and active LADAR sensors for moving target identification and track association in dense target areas.				
(U)					
(U)	MAJOR THRUST: Develop countermeasure technologies for use against IR- and EO-guided missile threats.	2.442	1.995	2.919	2.246
(U)	In FY 2006: Evaluated countermeasure techniques to defeat first generation IR imaging missile seekers. Conducted the exploitation of advanced IR missiles and IR sensor technology for countermeasure technique updates and refinement. Developed active sensing technology to defeat multi-band IR sensors.				
(U)	In FY 2007: Complete evaluation of countermeasure techniques to defeat first generation IR imaging missile seekers. Initiate development of second generation IR imaging missile seeker models/simulations for countermeasure technique development. Continue exploitation of advanced IR missiles and IR acquisition sensors for countermeasure technique updates and refinement. Conduct laboratory assessments of active sensing technology to evaluate capabilities against multi-band IR sensors.				
(U)	In FY 2008: Continue development of second generation IR imaging missile seeker models/simulations				

Exhibit R-2a, RDT&E Project Justification		DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE: 2003 EO Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	for countermeasure technique development. Continue exploitation of advanced IR missiles and IR acquisition sensors for countermeasure technique updates and refinement. Initiate identification of discriminants for specific identification of new EO sensors and missile threats.				
(U)	In FY 2009: Evaluate countermeasures techniques to defeat second generation IR imaging missile seekers. Develop new countermeasure technique updates and refinement applicable to legacy systems. Continue identification of discriminants for specific identification of new EO sensors and missile threats.				
(U)					
(U)	MAJOR THRUST: Develop aerospace missile and laser warning technologies to accurately cue countermeasures.	1.715	0.698	0.667	0.754
(U)	In FY 2006: Completed developing a laser threat scenario testbed for sensor technology evaluations. Developed new laser warning sensor technologies to address ultra-short and tunable laser threats. Developed advanced laser warning concepts for aircraft, to include integration into UAVs and night vision goggles (NVG).				
(U)	In FY 2007: Continue developing laser warning sensor concepts for UAVs and NVGs. Continue developing new laser warning sensor technologies to address ultra-short and tunable laser threats. Initiate development of an advanced laser warning concept for integration into tactical aircraft.				
(U)	In FY 2008: Continue developing new laser warning sensor technologies to address ultra-short and tunable laser threats. Identify methods to increase focal plane array dynamic range for precise characterization of low power and high power laser threats.				
(U)	In FY 2009: Continue developing new laser warning sensor technologies to address ultra-short and tunable laser threats. Identify clutter suppression techniques to increase signal to noise and improve detection ranges in urban operations. Evaluate algorithms to optimize detection/declaration ranges.				
(U)					
(U)	CONGRESSIONAL ADD: Watchkeeper.	4.096	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Watchkeeper.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Super-Resolution Sensor System.	3.218	1.694	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for the Super-Resolution Sensor System.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2003 EO Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2007: Conduct Congressionally-directed effort for the Super-Resolution Sensor System.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSSIONAL ADD: Optically Pumped Atomic Laser (OPAL).	0.975	1.992	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for OPAL.				
(U)	In FY 2007: Conduct Congressionally-directed effort for OPAL.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: WBI LADAR Development and Demonstration	0.000	1.992	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for WBI LADAR Development and Demonstration.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	22.141	22.111	16.077	16.346

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602500F, Multi-Disciplinary Space Technology.										
(U) PE 0603253F, Advanced Sensor Integration.										
(U) PE 0602301E, Intelligence System Program.										
(U) This project has been coordinated through the Reliance 21 process to										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2003 EO Sensors & Countermeasures Tech

(U) C. Other Program Funding Summary ($ in Millions)

harmonize efforts and
eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE: 44SP Space Sensors	

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
44SP Space Sensors	0.000	8.848	10.244	8.948	10.556	10.477	10.541	10.775	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2007, efforts will transfer from PE 0602500F, Multi-Disciplinary Space Technology, Project 5028, Space Sensors, Photonics, and RF Processors and Project 5029, Space Sensor and CM Technology, to this project in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project focuses on developing methods of generating, controlling, receiving, transmitting, and processing electronic, photonic, optical, and opto-electronic (mixed) signals for radio frequency (RF) space sensor applications. The enabling technologies will be used for intelligence, surveillance, reconnaissance (ISR), electronic warfare, and precision engagement sensors based in space. This project develops the baseline technologies required to manage and perform on-board space sensor information fusion for timely and comprehensive communications and situational awareness. Through modeling and simulation, this project develops and evaluates innovative electromagnetic and electronic countermeasures for space applications. This project aims to demonstrate significantly improved military space sensors of smaller size, lower weight, lower cost, lower power dissipation, higher reliability, and improved performance. This project also develops and assesses multi-dimensional adaptive techniques in radar technology for affordable and reliable space surveillance and reconnaissance systems.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	0.000	3.970	3.161	4.092

(U) MAJOR THRUST: Develop hybrid space-based sensor solutions and reduce associated technology risks. Investigate hardware and software implementation approaches for the needs of responsive space and of difficult targets from space. Develop space-qualified precision time, position, and velocity sensors capable of operating in jamming environments while enabling multiple platform sensor-to-warfighter operations. Note: In FY 2007, space-based sensor platform technology efforts, previously performed under other major thrusts in the Project, were placed here to show greater emphasis.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Initiate identification and development of specific techniques and technologies to further expand the capabilities of space-based sensor platforms.

(U) In FY 2008: Define responsive space sensor functional capabilities and implementation assessments. Model size, weight, and power (SWaP)-restricted precision time, position, and velocity sensor techniques for space-based applications. Develop constructive systems engineering model to assess space-based assured reference techniques in terms of measures of performance and warfighter utility.

(U) In FY 2009: Experimentally assess feasibility of responsive "plug- n- play" satellite implementation concept. Design SWaP-restricted precision time, position, and velocity sensor techniques for space-based applications. Demonstrate constructive systems engineering model to assess space-based assured reference techniques in terms of measures of performance and warfighter utility.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 44SP Space Sensors

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)					
(U)	MAJOR THRUST: Develop advanced active phased array antenna subsystems to meet the unique requirements of affordable space based sensing including the restrictions on mass, size, power. Utilize advanced materials to demonstrate low-mass, low cost, reliable and scalable apertures. Develop multi-band and multi-beamforming technologies. Address technologies for antenna array operations in dynamic sensor networks. Supports ISR capability.	0.000	2.215	3.199	0.954
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Demonstrate low-mass scalable tiles/panels with advanced thermal management and improved efficiency for active components.				
(U)	In FY 2008: Develop sub-array level digital beamforming and low-cost L-band antenna panels.				
(U)	In FY 2009: Experimentally assess enhanced antenna signal interference compatibility capability.				
(U)					
(U)	MAJOR THRUST: Study adaptive processing techniques for large, multi-mission, space-based conformal arrays to meet the stringent demands of wide area coverage, target detection, and target tracking in severe clutter and interference environments.	0.000	1.733	1.819	1.859
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop adaptive processing techniques suitable for implementation on space-qualified computing architectures for multi-intelligence ISR sensing from space-based platforms. Develop signal processing methods and novel adaptive transmit waveform techniques for a space surveillance platform.				
(U)	In FY 2008: Evaluate adaptive transmit and receive techniques for surface moving target indication (SMTI) from space under a variety of tactical scenarios and interference environments.				
(U)	In FY 2009: Integrate developed algorithms, waveforms and space platform scenarios into a surveillance network of sensors.				
(U)					
(U)	MAJOR THRUST: Develop advanced component technology for space-based sensors that focuses on improving performance and reducing size, mass, and prime power. Investigate pre-space qualification issues associated with newer component technologies to ensure more rapid and accurate transitions. Supports ISR capability.	0.000	0.930	0.752	0.679
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Develop and model an initial reduced power architecture for large area antennas.				
(U)	In FY 2008: Validate new low-cost RF sub-assembly technology compatibility for space qualification. Evaluate plastic packaging, liquid crystal polymer packages, and RF-on-Flex boards.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 44SP Space Sensors

(U) B. Accomplishments/Planned Program ($ in Millions)

		FY 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2009: Develop compact tunable filters for interference signal rejection in dense signal environments.				
(U)					
(U)	MAJOR THRUST: Develop sensor technologies to achieve highly accurate and robust navigation performance for hypersonic air vehicles in prompt global strike applications. Note: This work is an outgrowth of other efforts within this Project.	0.000	0.000	1.313	1.364
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Model hypersonic air vehicle plasma characteristics, platform trajectories, and highly accurate and robust navigation techniques for space-based applications. Develop constructive systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility.				
(U)	In FY 2009: Design RF 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. Demonstrate constructive systems engineering model to assess hypersonic navigation techniques in terms of measures of performance and warfighter utility.				
(U)	Total Cost	0.000	8.848	10.244	8.948

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602500F, Multi-Disciplinary Space Tech.										
(U) PE 0603203F, Advanced Aerospace Sensors.										
(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Tech.										
(U) This project has been coordinated through the Reliance 21 process to										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 44SP Space Sensors

(U) C. Other Program Funding Summary ($ in Millions)

harmonize efforts and
eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE: 4916 Electromagnetic Tech	

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4916 Electromagnetic Tech	17.746	21.252	12.513	11.808	11.625	12.178	12.449	12.751	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops technologies for sensor systems that cover the electromagnetic (EM) spectrum--from radio frequency (RF) to electro-optical (EO). It develops RF antennas and associated electronics for airborne and space-based surveillance. It also investigates RF scattering phenomenology for applications in ground and air moving target indicators in extremely cluttered environments. The project develops active and passive EO sensors for use in concert with RF 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.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Investigate detection of difficult airborne and ground-based targets in clutter from airborne or space-based surveillance platforms.	2.923	3.563	3.128	3.234
(U) In FY 2006: Developed integration techniques for combining EM target and clutter physics models with signal processing for improved target detection.				
(U) In FY 2007: Develop integration techniques for multiple platforms, combining EM target and clutter physics models with signal processing for improved target detection.				
(U) In FY 2008: Develop techniques for fully adaptive sensing and processing combining EM phenomenology, cognitive algorithms and signal processing pertaining to waveform diverse sensing and distributed sensing.				
(U) In FY 2009: Develop 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 EM models of targets and clutter.				
(U)				
(U) MAJOR THRUST: Design and develop antennas for airborne and space-based surveillance.	3.111	3.774	3.331	3.444
(U) In FY 2006: Developed and demonstrated novel RF and digital hardware architectures and embedded algorithms that achieve wideband digital beamforming for multi-function phased arrays. Analyzed and developed advanced 3-D micro-electro-mechanical systems (MEMS) RF structures that improve RF circuit design flexibility and reduce the size and cost of microwave integrated circuits. Investigated and developed novel designs for rugged, wideband, low-profile conformal antennas for airborne applications.				
(U) In FY 2007: Develop nonlinear embedded algorithms that enhance dynamic range and bandwidth of digital beamforming hardware, enabling the use of lower cost hardware. Demonstrate the integration of				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 4916 Electromagnetic Tech

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
microwave integrated circuits into low-cost 3-D MEMS RF structures designed for a miniature seeker radar. Analyze and develop digital beamforming architectures for conformal phased array antennas for future air-to-air radar system applications.				
(U) In FY 2008: Integrate optimal algorithms with mixed circuit RF wide-band beamforming hardware to demonstrate lower cost lightweight sensor platforms. Demonstrate low-cost miniature seeker hardware. Transition newly developed digital beamforming architectures to new airborne radar platforms.				
(U) In FY 2009: Develop new low-cost digital beamforming techniques for miniature unmanned aerial vehicle (UAV). Integrate new detection algorithm with low cost seeker hardware. Integrate and test new conformal digital beamforming phased array antennas on airborne radar platforms.				
(U)				
(U) MAJOR THRUST: Design and develop new EO techniques and components for detecting and identifying concealed targets.	2.545	3.281	2.724	2.816
(U) In FY 2006: Tested newly developed avalanche photo diodes (APD) integrated with electronic readout circuits. Integrated subcomponents with flash laser radar (LADAR) system and performed live tests to evaluate guidance and range resolution capability. Tested and evaluated next generation APD designs and incorporated in 3-D LADAR test-bed. Developed quasi-phased matched materials for laser wavelength conversion applications.				
(U) In FY 2007: Develop Zinc Oxide (ZnO), Aluminum Nitride (AlN) and Gallium Nitride (GaN) semiconductors for high power, high temperature EO applications. Develop single crystal GaN substrates for use in detection of biological agents in clouds and in harsh battlefield environments. Use developed LADAR techniques to extend range of agent and target detection. Develop ZnO, GaN, and AlN-based APDs for increased range and detection sensitivity and for non-line-of-sight covert communications.				
(U) In FY 2008: Develop new Focal Plane Array (FPA) materials and APD device technologies to enhance autonomous munitions, staring FPAs, target identification and tracking applications. Develop 2-D pixel-based electronic control circuits for enhanced imaging. Integrate these FPAs with the electronic control circuits for a compact 3-D FPA capability.				
(U) In FY 2009: Develop new quasi-phase matched materials such as Gallium Phosphate (GaP) and techniques for efficient optical sources in the mid- and long- wave IR applications. Develop new material systems to enable conversion from pump wavelengths between one and two microns. Continue testing of integrated FPA.				
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 4916 Electromagnetic Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Develop hardware and software for passive multi-dimensional sensing in the thermal infrared spectral wavelength range at high frame rates.	3.110	3.661	3.330	2.314
(U)	In FY 2006: Designed dual band tomographically based sensor system utilizing Cross Dispersion Prism (CDP) to characterize energetic battlefield events in real-time. Created CDP prototype and began in-house calibration and performance evaluation. Refined CDP techniques used to validate target declaration and reduce false alarms. Designed and developed micro-lens multi-spectral sensor for real-time threat warning and battle damage assessment.				
(U)	In FY 2007: Continue evaluation of CDP-based sensor system performance. Expand evaluation of CDP-based sensor system to field testing of various assets of interest and integration of CDP for target validation and reduction of false alarms. Continue design and development of micro-lens multi-spectral sensor for real-time threat warning and battle damage assessment. Evaluate micro-lens multi-spectral sensor performance for real-time threat warning and battle damage assessment.				
(U)	In FY 2008: Perform critical technical assessments via field testing on hyperspectral EO sensors developed in prior years. Evaluate the potential of sensing rapidly changing EO spectra from hot battlefield events (rocket propelled grenades, mortars, man-portable air defense systems, muzzle flash). Use results of collections to define small portable systems that can be fielded to provide rapid tactical information to commanders about the location and type of weapons being fired at friendly forces. Perform initial testing on a new hyperspectral approach to finding and identifying toxic gas clouds.				
(U)	In FY 2009: Develop new EO sensor hardware for detecting chemical, biological, radiological, and nuclear weapons using spectral/hyperspectral intelligence. Perform initial testing to assess sensor detection and identification, viability, and initiate plan for transition. Continue development of hyperspectral and multispectral sensors and create a small, deployable instrument suitable for moving into transition with an advanced technology demonstrator. Initiate utility assessment of hyperspectral sensors for collecting data at millisecond sample rates for space based applications.				
(U)					
(U)	CONGRESSIONAL ADD: Optical Maximum Entropy Verification (OMEV).	0.976	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Optical Maximum Entropy Verification.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Stable Articulating Backbone for Ultralight Radar (SABUR).	0.975	0.000	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 4916 Electromagnetic Tech

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) In FY 2006: Conducted Congressionally-directed effort for SABUR.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Center for Advanced Sensor and Communication Antennas.	1.169	1.594	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for the Center for Advanced Sensor and Communication Antennas.				
(U) In FY 2007: Conduct Congressionally-directed effort for the Center for Advanced Sensor and Communication Antennas.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Phased Array Antenna Control Computer.	0.975	0.996	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for the Phased Array Antenna Control Computer.				
(U) In FY 2007: Conduct Congressionally-directed effort for the Phased Array Antenna Control Computer.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Compact Ultra-sensitive Optical Receiver for Smart and Loitering Standoff Weapons.	0.976	1.992	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for a Compact Ultra-sensitive Optical Receiver for Smart and Loitering Standoff Weapons.				
(U) In FY 2007: Conduct Congressionally-directed effort for a Compact Ultra-sensitive Optical Receiver for Smart and Loitering Standoff Weapons.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) CONGRESSIONAL ADD: Hanscom AFB Collaboration on Meta-Materials and Conformal Antenna Technologies.	0.986	0.996	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Hanscom AFB Collaboration on				

Exhibit R-2a, RDT&E Project Justification		DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE: 4916 Electromagnetic Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	Meta-Materials and Conformal Antenna Technologies.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Hanscom AFB Collaboration on Meta-Materials and Conformal Antenna Technologies.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Wideband Digital Airborne Electronic Sensing Array.	0.000	1.395	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionall-directed efforts for Wideband Digital Airborne Electronic Sensing Array.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	17.746	21.252	12.513	11.808

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602500F, Multi-Disciplinary Space Technology.										
(U) PE 0602702F, Command Control and Communications.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE: 6095 Sensor Fusion Technology	

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
6095 Sensor Fusion Technology	16.754	18.578	18.335	18.118	18.109	18.295	18.643	19.030	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) 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, automated target recognition (ATR), 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.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop and assess single and multi-sensor ATR and sensor fusion algorithms for rapidly finding, tracking, and targeting mobile targets.	2.720	2.214	2.182	2.362

(U) In FY 2006: Developed improvement in image formation and processing of synthetic aperture radar (SAR) data from research and development (R&D) data collections. Completed automated image analysis and truthing tools. Developed synthetic data generation tools to augment and enhance collected R&D and operational data sets. Completed initial ATR R&D computer and networking infrastructure via software, hardware, and network integration enhancements. Completed assessing the effectiveness of real-time ATR algorithms for time-critical targets on embedded high-performance computing systems. Conducted laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Conducted ATR performance evaluation theory research for radar, electro-optical (EO), and multiple sensor ATR technologies. Laboratory tested the first multi-sensor ATR performance prediction model. Assessed methods and measures for moving target tracking and identification (ID) approaches using multiple sensor types. Developed analysis methods and measures for assessing automated exploitation and rapid response systems proposed for post-conflict force protection, stability, and security operations.

(U) In FY 2007: Continue to develop improvement in image formation and processing of SAR data from R&D data collections. Continue development of synthetic data generation tools to augment and enhance collected R&D and operational data sets. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Complete initial ATR performance evaluation theory for radar ATR technology and continue for EO and multiple sensor ATR technologies. Laboratory test the first multi-sensor ATR performance prediction model. Continue assessment methods and measures for moving target tracking and ID approaches using multiple sensor types. Continue development of analysis methods and measures for assessing automated exploitation

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 6095 Sensor Fusion Technology

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
and rapid response systems proposed for post-conflict force protection, stability, and security operations.				
(U) In FY 2008: Develop improved image formation and processing of SAR data from R&D data collections to enhance those features that most impact ATR detection and classification performance. Continue to develop image and data formation and processing of EO, infrared (IR), and hyperspectral imaging (HSI) data from R&D data collections. Continue development of multi-sensor/multi-frequency synthetic data generation tools to augment and enhance collected R&D and operational data sets. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Enhance ATR performance evaluation techniques for radar ATR technology and continue for EO and multiple sensor ATR technologies. Continue assessment methods and measures for moving target tracking and ID approaches using multiple sensor types. Continue development of analysis methods and measures for assessing automated exploitation and rapid response systems proposed for post-conflict force protection, stability, and security operations.				
(U) In FY 2009: Assess the image formation and processing of SAR, EO/IR/HSI data from R&D data collections taking advantage of disparate phenomenology to improve ATR detection, classification and identification performance. Develop and validate multi-sensor/multi-frequency synthetic data generation tools required to augment and enhance collected R&D and operational data sets. Initiate development of tools and technology supporting other phenomenological features that heretofore have not been exploited. Continue laboratory tests and assessment of multi-sensor and sensor fusion algorithms for automated exploitation and weapon delivery systems. Enhance ATR performance evaluation techniques for radar ATR technology and continue for EO and multiple sensor ATR technologies. Continue assessment methods and measures for moving target tracking and ID approaches using multiple sensor types. Demonstrate initial analysis methods and measures for assessing automated exploitation and rapid response systems proposed for post-conflict force protection, stability, and security operations.				
(U)				
(U) MAJOR THRUST: Develop, evaluate, and demonstrate target signature models to support ATR and sensor fusion algorithm development and testing for reconnaissance and strike mission applications.	5.263	3.116	5.635	5.887
(U) In FY 2006: Matured target signature models for signature exploitation of radio frequency (RF) sensors, EO multi-spectral systems, and signals intelligence (SIGINT) sensors. Developed signatures, algorithms, and modeling support for RF and multiple EO phenomenology ATR of tactical ground targets. Generated synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Developed a synthetic scene data				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 6095 Sensor Fusion Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2006	FY 2007	FY 2008	FY 2009

generation capability for RF scenes applicable to large area reconnaissance coverage. Conducted investigation of model-driven spectral signal processing and exploitation techniques. Developed ATR algorithm-driven RF sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high diversity data.

(U) In FY 2007: Continue to mature target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and SIGINT sensors. Continue to develop signatures, algorithms, and modeling support for multiple RF and EO phenomenology ATR of tactical ground targets. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support ATR of targets in operationally realistic mission environments. Demonstrate a synthetic scene data generation capability for RF scenes and begin development of an EO scene capability applicable to large area reconnaissance coverage. Continue investigation of model-driven spectral signal processing and exploitation techniques. Continue development of ATR algorithm-driven RF sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high diversity data.

(U) In FY 2008: Develop and validate target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and SIGINT sensors. Develop signatures, algorithms, and modeling technologies and their supporting tools for analysis and evaluation for multiple RF and EO phenomenology ATR of tactical ground targets; introduce civilian vehicles. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Complete demonstration of a synthetic scene data generation capability for RF scenes and continue development of an EO scene capability applicable to large area reconnaissance coverage. Continue investigation of model-driven spectral signal processing and exploitation techniques. Measure performance of initial ATR algorithm-driven RF sensor design, including new modes of operation for existing sensors, and signal processing/exploitation for high diversity data.

(U) In FY 2009: Continue to mature target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and SIGINT sensors. Continue to develop signatures, algorithms, and modeling support for multiple RF and EO phenomenology ATR of tactical ground targets and civilian vehicles. Initiate the development of signatures, algorithms, target modeling and phenomenological modeling of other phenomenological features that heretofore have not been exploited. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Continue development of an EO scene capability applicable to large area reconnaissance coverage. Continue investigation of model-driven spectral signal

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 6095 Sensor Fusion Technology

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	processing and exploitation techniques. Continue development of ATR algorithm-driven RF sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high diversity data.				
(U)					
(U)	MAJOR THRUST: Develop and demonstrate enabling ATR, sensor management, and sensor fusion technologies for target detection, tracking, and identification in intelligence, surveillance, reconnaissance (ISR) and combat identification (CID) applications.	7.796	12.152	9.021	8.367
(U)	In FY 2006: Conducted fusion of exploitable radar, EO/infrared (IR), laser radar (LADAR), and hyperspectral features for target detection, tracking, and ID with sensor management techniques. Evaluated physics-based techniques for target detection and identification for ISR and CID applications. Transitioned to advanced development programs laboratory demonstrated advanced algorithms for detection and identification of targets under trees and/or in the presence of heavy camouflage, concealment, and deception. Developed technology that will capitalize on precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. 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 ATR for robustness. Researched ATR, sensor management, and sensor fusion for urban ISR from small unmanned aerial vehicles (UAVs).				
(U)	In FY 2007: Continue fusion of exploitable radar, EO/IR, LADAR, and hyperspectral features for target detection, tracking, and ID with sensor management techniques. Continue evaluation of physics-based techniques for target detection and ID for ISR and CID applications. Continue development of technology that will capitalize on precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Begin investigation of pixel level registration techniques. Continue development of capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Continue research of bio-inspired ATR for robustness. Continue ATR, sensor management, and sensor fusion research for urban ISR from small UAVs				
(U)	In FY 2008: Develop and validate a fusion capability that exploits radar, EO/IR, LADAR, and hyperspectral features for target detection, tracking, and ID with sensor management techniques. Evaluate physics-based techniques for target detection and identification for ISR and CID applications to determine technology shortfalls. Initiate development of automated battle space behavior analysis. Continue development and initiate assessment of technology that will capitalize on precision time,				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 6095 Sensor Fusion Technology

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Continue development of multi-sensor pixel level registration techniques. Continue development of capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Continue research of bio-inspired ATR for robustness. Extend ATR, sensor management, and sensor fusion research for urban ISR from small UAVs to include civilian objects of interest.				
(U) In FY 2009: Complete initial fusion capability for radar, EO/IR, LADAR, and hyperspectral features for target detection, tracking, and ID with sensor management techniques. Evaluate and improve physics-based techniques for target detection and identification for ISR and CID applications. Continue development and initiate evaluation of automated battle space behavior analysis. Continue development of technology that will capitalize on precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing; initiate its incorporation into fusion functions. Complete and evaluate initial multi-sensor, pixel level registration techniques. Continue development of capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Continue research of bio-inspired ATR for robustness and initiate evaluation of these techniques for urban applications. Evaluate ATR, sensor management, and sensor fusion research for difficult urban ISR from small UAVs for civilian objects of interest.				
(U)				
(U) MAJOR THRUST: Develop fundamental technical methods required for algorithm performance models, ATR driven sensing, layered sensing and other sensing and exploitation technologies impacted by ATR capabilities. Note: This work is an outgrowth of other work within this project.	0.000	0.000	1.497	1.502
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Assess the state of the art in ATR predictive methods. Determine exploitation and sensing technologies that require the integration of ATR techniques. Develop fundamental ATR approaches for various subcomponents.				
(U) In FY 2009: Evaluate new innovations in ATR related technologies. Continue development of fundamental ATR approaches for subcomponents. Begin development of integrated, unified ATR methodology building upon the various ATR subcomponent efforts.				
(U)				
(U) CONGRESSIONAL ADD: Advanced Sensor Aided Vigilance Technologies.	0.975	1.096	0.000	0.000

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 6095 Sensor Fusion Technology

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2006	FY 2007	FY 2008	FY 2009
(U) In FY 2006: Conducted Congressionally-directed effort for Advanced Sensor Aided Vigilance Technologies.				
(U) In FY 2007: Conduct Congressionally-directed effort for Advanced Sensor Aided Vigilance Technologies.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U) Total Cost	16.754	18.578	18.335	18.118

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602500F, Multi-Disciplinary Space Technology.										
(U) PE 0603203F, Advanced Aerospace Sensors.										
(U) PE 0602602F, Conventional Munitions.										
(U) PE 0603270F, Electronic Combat Technology.										
(U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.										
(U) PE 0603762E, Sensor and Guidance Technology.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-2a, RDT&E Project Justification		DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE: 6095 Sensor Fusion Technology

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE: 7622 RF Sensors & Countermeasures Tech	

Cost ($ in Millions)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
7622	RF Sensors & Countermeasures Tech	35.851	34.248	25.796	26.061	34.244	35.088	31.301	32.016	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2006 efforts in Project 5017 transferred to this project in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops and assesses affordable, reliable all weather radio frequency (RF) sensing concepts for aerospace applications covering the range of radar sensors including intelligence, surveillance, reconnaissance (ISR) and fire control, both active and passive. This project also develops and evaluates technology for ISR, fire control radar, electronic combat (EC), and integrated radar and EC systems. It emphasizes the detecting and tracking of surface and airborne targets with RF 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 RF phenomenologies, multi-dimensional adaptive processing, advanced waveforms, and knowledge-aided processing techniques. This project also develops the RF warning and countermeasure technology for advanced EC applications. Specifically, it develops techniques and technologies to detect and counter the 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 RF sensors, including radar warning, RF EC, and electronic intelligence applications.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop affordable RF jamming technology and concepts that enhance aerospace vehicle survivability by degrading enemy radar, missile, and command and control systems. Note: Effort completes in FY 2006.	1.684	0.000	0.000	0.000
(U) In FY 2006: Completed development and test of a complex signal communication environment simulator that contains both adversary and friendly advanced spread spectrum signals. Completed development and test of technology for an advanced digital communications jammer. Completed exploitation evaluations against new, advanced RF threats. Performed exploratory research into development of networked electronic attack techniques.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) MAJOR THRUST: Develop advanced waveforms for achieving transmit adaptivity and simultaneous multi-mode operation to improve interference rejection, self-protection, and target identification by exploiting diversity in frequency, delay, polarization, and modulation and coding. Develop technologies	5.099	18.196	12.759	15.887

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 7622 RF Sensors & Countermeasures Tech

(U) **B. Accomplishments/Planned Program ($ in Millions)** FY 2006 FY 2007 FY 2008 FY 2009

and techniques to provide significant size, weight, and power (SWaP) reductions in RF sensors compatible with severely constrained unmanned air platforms. Develop technology to enable affordable upgrades to RF signal receivers. Note: There is increased emphasis on this effort beginning in FY 2007.

(U) In FY 2006: Identified and analyzed advanced receiver/exciter techniques for operation with temporally and spatially adaptive electronic support (ES) and radar antenna systems. Identified and analyzed advanced digital signal processing techniques that support distributed and adaptive ES and radar receiver/exciter sensor systems. Minimized SWaP for advanced apertures and receivers, waveform diversity, assured reference, and machine-to-machine sensor cross cueing. Investigated innovative techniques to provide concurrent RF radar and electronic warfare (EW) with electro-optical (EO) compatibility on a single platform. Developed integrated radar and EW modeling, simulation, and analysis capabilities to address system-level multi-intelligence trades.

(U) In FY 2007: Develop and evaluate advanced digital receiver/exciter technologies for ES and radar applications that support multiple degree-of-freedom adaptivity. Develop and evaluate advanced signal processing concepts that seamlessly integrate with receiver technologies to support increased levels of adaptivity for operation in complex signal environments. Continue development to reduce size, weight, and power in RF sensors compatible with severely constrained unmanned air platforms. Refine innovative techniques to provide concurrent RF radar and EW with EO compatibility on a single platform. Determine system-level multi-intelligence trades through integrated radar and EW modeling, simulation, and analysis.

(U) In FY 2008: Develop and evaluate advanced mode control concepts to provide concurrent multi-function RF radar and electronic warfare (EW) compatibility on a single platform. Develop integrated RF (radar and EW) and EO modeling, simulation, and analysis capabilities to address broader system-level multi-intelligence trades. Develop advanced digital receiver techniques for adaptive ES for passive multi-mode platform operations. Continue development and evaluation of advanced digital receiver/exciter technologies for ES and radar applications that support multiple degrees-of-freedom adaptivity. Continue development and evaluation of advanced digital receiver signal processing concepts/techniques for adaptive operation in complex signal environments. Perform digital receiver simulation, modeling and analysis for ES scenarios in modern signal environments. Refine reductions in size, weight, and power in RF sensors compatible with severely constrained unmanned air platforms.

(U) In FY 2009: Continue system-level multi-intelligence trades through integrated RF (radar and EW) and

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 7622 RF Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	EO modeling, simulation, and analysis. Continue to develop and evaluate advanced mode control concepts to provide concurrent RF radar and EW with EO compatibility on a single platform. Define approaches allowing the simultaneous design and development of sensors and their back-end exploitation functions. Develop advanced ES digital receiver concepts/techniques for spatial and temporal adaptivity to overcome limitations to precision emitter parameterization in complex environments. Continue development and evaluation of advanced adaptive digital receiver/exciter technologies for ES, radar and passive multi-mode applications. Continue digital receiver simulation, modeling and analysis for ES scenarios in modern signal environments. Continue to refine reductions in size, weight, and power in RF sensors compatible with severely constrained unmanned air platforms.				
(U)					
(U)	MAJOR THRUST: Develop robust, ultra-widebandwidth antenna technology for use in operational and future aerospace platform electronic apertures. Develop innovative technologies and architectures for extremely wideband apertures to provide for more functionality on a set of platforms. Assess next generation applied RF aperture technology.	6.077	4.362	1.004	0.883
(U)	In FY 2006: Designed and modeled thin profile, wideband arrays for ES receive applications. Designed and fabricated array beam steering capability for wideband array jammer transmitter. Designed and modeled compact, wideband direction finding antenna. Extended bandwidth performance of unique, low profile, low-cost antenna element.				
(U)	In FY 2007: Fabricate and test thin profile, wideband receive array. Extend array to accommodate transmit function. Evaluate performance of directional wideband array transmitter. Complete fabrication and test of compact, wideband direction finding antenna for close in sensing.				
(U)	In FY 2008: Integrate compact digital receiver/exciter to thin-profile array.				
(U)	In FY 2009: Lab demonstrate and test thin profile array with integrated receiver/exciter.				
(U)					
(U)	MAJOR THRUST: Develop multi-function RF sensing concepts and RF transformational element level arrays for concurrent multi-mode operation.	2.103	2.822	3.109	1.807
(U)	In FY 2006: Fabricated and laboratory tested low-cost millimeter wave sensor that provides height indication in addition to azimuth and range for landing in obscured environments. Designed distributed position, navigation, and time (PNT) virtual testbed to assess assured reference techniques that achieve optimal multi-function RF sensor fusion for a Common Operation Picture (COP). Extended array simulations to determine technology shortfalls for full element level digital beam forming (DBF).				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 7622 RF Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2007: Design autonomous constellation of active and passive air, space, and ground sensor techniques for close-in sensing applications using distant sources of opportunity. Perform systems engineering analysis of concurrent operation to determine multi-mode array performance. Initiate technology development of critical subsystems for element level multi-mode DBF.				
(U)	In FY 2008: Develop autonomous constellation of active and passive air, space, and ground sensor techniques for close-in sensing applications using distant sources of opportunity. Design and develop panel technology for multi-mode array to demonstrate concurrent operation.				
(U)	In FY 2009: Lab demonstrate autonomous constellation of active and passive air, space, and ground sensor techniques for close-in sensing applications using distant sources of opportunity. Demonstrate and test multi-mode array with element level DBF.				
(U)					
(U)	MAJOR THRUST: Develop digital RF receiver/exciter technology to support DBF.	6.027	3.669	3.739	1.522
(U)	In FY 2006: Developed and modeled DBF-specific receiver/exciter technologies that stress reduced size, weight, and power consumption, as well as increased affordability for ES and radar sensor systems. Demonstrated through simulation and laboratory integration the benefits for DBF receiver/exciter technologies for multi-intelligence RF sensor systems.				
(U)	In FY 2007: Demonstrate receiver/exciter technologies that support DBF functionality for advanced electronic support and radar sensor systems. Perform laboratory integration and demonstration of reduced size, weight and power consumption receiver/exciter technologies that support multi-function RF sensor concepts.				
(U)	In FY 2008: Develop subsystem engineering, simulation, and characterization technologies for integrated wideband RF aperture, wideband receiver/exciter, and DBF signal processing.				
(U)	In FY 2009: Lab demonstrate advanced wideband RF aperture and wideband receiver/exciter with DBF signal processing subsystem to validate subsystem engineering, simulation, and characterization technologies.				
(U)					
(U)	MAJOR THRUST: Design exploratory outdoor time transfer experiments between multiple moving platforms for enhanced situational awareness. Investigate techniques for multi-intelligence data acquisition from a single platform. Note: Effort completes in FY 2006.	0.911	0.000	0.000	0.000
(U)	In FY 2006: Demonstrated critical experiments in innovative time transfer techniques for network centric warfare applications. Developed engineering tools to implement advanced electronic				

Exhibit R-2a, RDT&E Project Justification		DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE: 7622 RF Sensors & Countermeasures Tech

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
counter-countermeasure (ECCM) techniques. Validated the engineering tools using both synthetic and field collected data.				
(U) In FY 2007: Not Applicable.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) MAJOR THRUST: Develop advanced waveforms for achieving transmit adaptivity and simultaneous multi-mode operation to improve interference rejection, self-protection, and target identification by exploiting diversity in frequency, delay, polarization, and modulation and coding. Develop multi-platform, multi-mission radar adaptive processing algorithms that improve detection and location performance for advanced cruise missiles, air- and ground-based targets in severe clutter and jamming environments.	6.733	4.203	5.185	5.962
(U) In FY 2006: Evaluated advanced adaptive transmit waveforms for single- and multi-mode operation to improve interference rejection, self-protection, target identification, and ambiguity resolution using temporal, spatial, frequency, and polarization diversity. Optimized waveforms for multi-sensor, multi-mode operations for moving target indicator (MTI) surveillance platforms. Developed advanced radar signal processing algorithms for multi-sensor, multi-mode operation. Completed initial development of wideband and polarization adaptive processing techniques for multi-function radar. Evaluated adaptive processing techniques for multi-mission conformal arrays. Completed initial development of distributed processing technology for next generation deep-reach target detection and tracking.				
(U) In FY 2007: Develop optimal waveforms for multi-sensor/multi-mode radar. Develop advanced radar signal processing algorithms that are suitable for multi-sensor, multi-mode operation. Evaluate wideband radar signal processing techniques for MTI surveillance platforms. Evaluate distributed processing technology for next generation deep-reach target detection and tracking.				
(U) In FY 2008: Evaluate distributed processing technology for next generation deep-reach target detection and tracking. Utilize high fidelity simulation tools. Plan for future experiments.				
(U) In FY 2009: Initiate and conduct experiments to demonstrate the advantages and performance improvements of adaptive transmit waveforms, new distributed sensor receive processing techniques, and distributed sensing.				
(U)				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 7622 RF Sensors & Countermeasures Tech

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	CONGRESSIONAL ADD: Minority LEADERS Research Program.	1.756	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for the Minority LEADERS Research Program.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Small Disadvantaged Business, Historically Black Colleges and Universities.	5.461	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Small Disadvantaged Business, Historically Black Colleges and Universities.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Sensor Network Technology.	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Conduct Congressionally-directed effort for Sensor Network Technology.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	Total Cost	35.851	34.248	25.796	26.061

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602500F, Multi-Disciplinary Space Technology.										
(U) PE 0603203F, Advanced Aerospace Sensors.										
(U) PE 0603253F, Advanced Avionics Integration.										

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602204F Aerospace Sensors**	PROJECT NUMBER AND TITLE **7622 RF Sensors & Countermeasures Tech**

(U) C. Other Program Funding Summary ($ in Millions)

(U) PE 0602782A, Command, Control, Communications Technology.

(U) PE 0602232N, Navy C3 Technology.

(U) PE 0603792N, Advanced Technology Transition.

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.