

UNCLASSIFIED

PE NUMBER: 0603203F
 PE TITLE: Advanced Aerospace Sensors

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2008
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BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors
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Cost (\$ in Millions)	FY 2007 Actual	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	56.634	62.332	56.916	58.664	55.847	58.408	57.244	0.000	0.000
665A Advanced Aerospace Sensors Technology	17.892	17.880	16.542	26.085	23.331	21.707	20.331	0.000	0.000
69DF Target Attack and Recognition Technology	27.015	32.220	30.130	25.921	25.709	28.589	29.102	0.000	0.000
88SP Advanced Space Sensors	11.727	12.232	10.244	6.658	6.807	8.112	7.811	0.000	0.000

Note: In FY 2007, Project 88SP, Advanced Space Sensors, efforts were transferred from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5034, Advanced Space Sensors, in order to more effectively manage and provide oversight of the efforts. Funds for the FY 2008 Congressionally-directed Moving Target Strike in the amount of \$1.6 million are in the process of being moved from PE 0603203F, Advanced Aerospace Sensors, to PE 0603601F, Conventional Weapons Technology, for execution.

(U) A. Mission Description and Budget Item Justification

Divided into three broad project areas, this program develops technologies to enable the continued superiority of sensors from aerospace platforms. The first project develops and demonstrates advanced technologies for electro-optical sensors, radar sensors and electronic counter-countermeasures, and components and algorithms. The second project develops and demonstrates radio frequency and electro-optical sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets obscured by natural or man-made means. The third project develops and demonstrates space sensor technologies including radio-frequency sensors; intelligence, surveillance, and reconnaissance sensors; electro-optical sensors; laser warning sensors; targeting and attack radar sensors; and electronic counter-countermeasures and communications. Together, the projects in this program develop the means to find, fix, target, track, and engage air and ground targets anytime, anywhere, and in any weather. Note: In FY 2008, Congress added \$3.2 million for TACNODES and \$4.0 million for Active Unmanned Air Vehicle (UAV) Phenomenology (AUP) & ART Technology Transition. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and electronic combat system developments that have military utility and address warfighter needs.

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

	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Previous President's Budget	58.228	55.549	52.840
(U) Current PBR/President's Budget	56.634	62.332	56.916
(U) Total Adjustments	-1.594	6.783	
(U) Congressional Program Reductions		-0.007	
Congressional Rescissions		-0.410	
Congressional Increases		8.800	
Reprogrammings	-0.301	-1.600	
SBIR/STTR Transfer	-1.293		

(U) **Significant Program Changes:**

In FY 2007, Project 88SP, Advanced Space Sensors, efforts transferred from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5034, Advanced Space Sensors, in order to more effectively manage and provide oversight of the efforts.

C. Performance Metrics

Under Development.

Exhibit R-2a, RDT&E Project Justification

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Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
665A Advanced Aerospace Sensors Technology	17.892	17.880	16.542	26.085	23.331	21.707	20.331	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

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

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

	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) MAJOR THRUST: Develop integrated electro-optical sensor technologies to search, detect, locate, and identify air and ground targets at ranges significantly longer than currently achievable, including targets that are camouflaged, low-observable, or employ other means of deception. Note: Funding peaks in FY 2008 due to the final increment of funding to develop the three-dimensional laser detection and ranging system supporting automated/assisted target recognition of obscured and urban targets, and the start of the system engineering and integration phase of that effort.	3.946	6.725	4.212
(U) In FY 2007: Continued development of a multi-function active/passive electro-optical/infrared sensor demonstration system to detect, locate, and identify difficult targets in both obscured and urban environments for intelligence, surveillance, and reconnaissance applications. Finalized analysis of advanced passive and multi-function active sensing methods to optimize detection and identification of difficult targets. Completed design for multi-mode unmanned aerial vehicle based sensor, including platform integration plans. Initiated development of coarse-to-fine sensing methodologies which progress from wide area search to pinpoint identification and characterization. Incorporated long-wave infrared spectral/polarimetric imager into high altitude sensor. Conducted flight test to demonstrate target detection capability. Finalized the design and initiate fabrication of an engineering model for an improved three-dimensional laser detection and ranging system which has improved range and resolution capability to support automated/assisted target recognition of obscured and urban targets.			
(U) In FY 2008: Begin airborne experiments demonstrating multi-function active/passive electro-optical/infrared demonstration system to detect, locate, and identify difficult targets in both obscured and urban environments for intelligence, surveillance, and reconnaissance applications. Perform fabrication and testing of high-resolution, three-dimensional laser radar for high confidence target identification coupled with passive spectral imaging for low false alarm rate detection utilizing advanced change detection and spatial-spectral discrimination techniques.			

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(U) B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Perform concept demonstration of multispectral/polarimetric focal plane array device for enhanced low contrast target discrimination. Complete fabrication of improved three-dimensional laser detection and ranging system and conduct testing of the engineering model.				
(U) In FY 2009: Continue airborne experiments demonstrating multi-function active/passive electro-optical/infrared demonstration system to detect, locate, and identify difficult targets in both obscured and urban environments for intelligence, surveillance, and reconnaissance applications. Characterize end-to-end performance of high-resolution, three-dimensional laser radar for high confidence target identification coupled with passive spectral imaging for low false alarm rate detection utilizing advanced change detection and spatial-spectral discrimination techniques. Complete development of multispectral/polarimetric focal plane array device for enhanced low contrast target discrimination, and design airborne sensor module for enhancement of multi-function demonstration system.				
(U)				
(U) MAJOR THRUST: Develop electro-optical sensor technologies to detect and locate camouflaged and concealed targets for aerospace intelligence, surveillance, and reconnaissance applications. Note: This effort ends in FY 2007.		4.928	0.000	0.000
(U) In FY 2007: Completed fabrication and testing of demonstration system for high-altitude aircraft incorporating reflective and emissive spectral sensing capability for day and night operations. Performed flight characterization and supported transition to acquisition center.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) MAJOR THRUST: Develop technologies to maximize positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities.		2.291	2.298	1.798
(U) In FY 2007: Demonstrated critical experiments using virtual flight test simulation to characterize assured reference technologies for net centric warfare. Developed sensor phenomenology-based georegistration for imagery and performed lab tests of multi-intelligence georegistration.				
(U) In FY 2008: Develop worldwide ultra-accurate positioning system technologies to optimize time sensitive targeting, battlespace awareness, and persistent intelligence, surveillance, and reconnaissance capabilities. Continue to develop multi-sensor phenomenology-based georegistration for imagery and perform lab tests of multi-intelligence georegistration.				
(U) In FY 2009: Demonstrate worldwide ultra-accurate positioning system technologies to optimize time sensitive targeting, battlespace awareness, and persistent intelligence, surveillance, and reconnaissance capabilities. Continue to develop multi-sensor phenomenology-based georegistration for imagery and perform lab tests of multi-intelligence				

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

georegistration.

FY 2007FY 2008FY 2009

(U)

(U) MAJOR THRUST: Develop, test, evaluate, and demonstrate lightweight, low power, compact radio-frequency sensors to detect, track, and target high-value, time-critical targets that are difficult to detect through either stealth or concealment and enable persistent intelligence, surveillance, and reconnaissance from an unmanned aerial vehicle. Develop and validate long-range intelligence, surveillance, and reconnaissance sensor technologies and techniques for the detection and track of advanced air and ground targets. Advanced target characteristics include targets with low radar cross section, concealment capabilities, or electronic counter-countermeasures. Note: The growing emphasis in this thrust in FY 2008 and FY 2009 is due to the increased focus on multi-intelligence radio-frequency systems.

3.886

4.748

9.765

(U) In FY 2007: Continued demonstration of the radio-frequency sensors of an integrated electro-optical/radio-frequency sensor suite for unmanned aerial vehicles with severe size, weight, and power constraints, to enable single platform persistent intelligence, surveillance, and reconnaissance capabilities compatible with a system of systems architecture. Developed highly integrated receiver-aperture technologies for improved functionality and greatly reduced size, weight, and power. Continued experiments with the ground test bed providing input into a design for an airborne multi-intelligence experiment. Continued radar systems engineering support fostering the transition of developed enabling technologies and concepts to weapon systems and intelligence, surveillance, and reconnaissance assets. Developed program for threat analysis/mitigation of passive multistatic, multi-intelligence sensing.

(U) In FY 2008: Continue demonstration of the radio-frequency sensors of an integrated electro-optical/radio-frequency sensor suite (for unmanned aerial vehicles with severe size, weight, and power constraints), to enable single platform persistent intelligence, surveillance, and reconnaissance capabilities compatible with a system of systems architecture. Continue experiments with the ground test bed providing input into the required operation and controls for an airborne multi-intelligence experiment. Continue radar systems engineering support fostering the transition of developed enabling technologies and concepts to weapon systems and intelligence, surveillance, and reconnaissance assets. Initiate a radar system analysis for improved air and ground target detection and tracking using cross-cued, dual-band radar.

(U) In FY 2009: Continue demonstration of the radio-frequency sensors of an integrated electro-optical/radio-frequency sensor suite for unmanned aerial vehicles with severe size, weight, and power constraints, to enable single platform persistent intelligence, surveillance, and reconnaissance capabilities compatible with a system of systems architecture. Enhance the ground test bed with the inclusion of electro-optical sensing modes, and provide input into

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(U) B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
the required design for an integrated electro-optical/radio-frequency sensor suite, including required data processing and exploitation. Continue sensor systems engineering support fostering the transition of developed enabling technologies and concepts to weapon systems and intelligence, surveillance, and reconnaissance assets. Continue experiments with the ground test bed providing input into a design for an airborne multi-intelligence experiment. Continue systems analysis for improved air and ground target detection and tracking using cross-cued, dual-band radar coupled with electronic support sensors.				
(U) MAJOR THRUST: Develop weapons guidance-quality track radar performance in advanced jamming environments. Develop and demonstrate advanced radar signal processing techniques to mitigate clutter and jamming interference and improve detection and tracking of difficult targets in hostile environments.		0.849	0.930	0.767
(U) In FY 2007: Demonstrated and evaluated novel space-time adaptive processing techniques that are robust to heterogeneous data. Demonstrated and evaluated multi-sensor waveform transmission and signal processing techniques on selected advanced computing architectures.				
(U) In FY 2008: Demonstrate and evaluate multi-sensor waveform transmission and signal processing techniques on selected advanced computing architectures. Implement novel space-time adaptive processing techniques that are robust to heterogeneous data. Implement tactical sensor network operations on the developed advanced computer architectures used for algorithm/waveform analysis.				
(U) In FY 2009: Demonstrate the surveillance performance of homogeneous sensor networks and newly developed adaptive processing algorithms and waveforms in heterogeneous conditions, including clutter and jamming interference.				
(U) CONGRESSIONAL ADD: Precision Image Tracking and Registration Program.		0.996	0.000	0.000
(U) In FY 2007: Conducted Congressionally-directed effort for the Precision Image and Tracking Registration Program.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U) CONGRESSIONAL ADD: Tactical Air Communication Nodes (TACNODES).		0.996	3.179	0.000
(U) In FY 2007: Conducted Congressionally-directed effort for TACNODES.				
(U) In FY 2008: Conduct Congressionally-directed effort for TACNODES.				
(U) In FY 2009: Not Applicable.				
(U)				

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(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Total Cost	17.892	17.880	16.542

(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>Cost to</u>	<u>Total Cost</u>
	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	
(U) Related Activities:									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603205F, Flight Vehicle Technology.									
(U) PE 0603707F, Weather Systems Advanced Development.									
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.									
(U) PE 0602111N, Weapons Technology.									
(U) PE 0602232N, Space and Electronic Warfare (SEW) Technology.									
(U) PE 0604249F, LANTIRN Night Precision Attack.									
(U) PE 0603270F, Electronic Combat Technology.									
(U) A Memorandum of Agreement has been established between Air Force Research Laboratory and Defense Advanced Research Projects Agency to jointly develop the technology required to detect high-value, time-critical targets in a variety of									

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

environments.

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

(U) D. Acquisition Strategy

Not Applicable.

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03 Advanced Technology Development (ATD)				0603203F Advanced Aerospace Sensors			69DF Target Attack and Recognition Technology		
Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
69DF Target Attack and Recognition Technology	27.015	32.220	30.130	25.921	25.709	28.589	29.102	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

(U) **A. Mission Description and Budget Item Justification**

This project develops and demonstrates advanced technologies for attack management, fire control, and target identification and recognition. This includes developing and demonstrating integrated and cooperative fire control techniques to provide for adverse-weather precision air strikes against multiple targets per pass and at maximum weapon launch ranges. Specific fire control technologies under development include attack management, sensor fusion, automated decision aids, advanced tracking for low radar cross section threats, and targeting using both on-board and off-board sensor information. This project also evaluates targeting techniques to support theater missile defense efforts in surveillance and attack. These fire control technologies will provide force multiplication and reduce warfighter exposure to hostile fire. This project also develops and demonstrates target identification and recognition technologies for positive, high confidence cueing, recognition, and identification of airborne and ground-based, high-value, time-critical targets at longer ranges than are currently possible. The goal is to apply these technologies to tactical air-to-air and air-to-surface weapon systems so they are able to operate in all weather conditions, during day or night, and in high-threat, multiple target environments. Model-based vision algorithms and target signature development techniques are the key to target identification and recognition. This project is maturing these technologies in partnership with the Defense Advanced Research Projects Agency, and evaluating the techniques to support theater missile defense efforts in surveillance and attack. Fire control and recognition technologies developed and demonstrated in this project are high leverage efforts, providing for significant advancements in operational capabilities largely through software improvements readily transitionable to new and existing weapon systems. Note: Funding in individual Major Thrusts in this project decrease in FY 2008 and FY 2009 as 1., technology is transitioned to operational platforms, and 2., several Major Thrusts are created as outgrowths of other work in the project for better management and oversight.

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

	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) MAJOR THRUST: Develop and test an automatic target recognition system for tracking and identifying moving and stationary ground targets for use in strike and reconnaissance platforms. Note: The reduced emphasis in this thrust in FY 2009 is due to the transition of the technology to the warfighter.	4.540	5.212	0.332
(U) In FY 2007: Continued multi-spiral development of a radar based air-to-ground moving target algorithm for tactical and reconnaissance platforms. Refined this capability for integration into candidate radar systems and platform specific product development roadmaps. Provided transition plans of the moving target algorithm technology to operational strike and reconnaissance platforms.			
(U) In FY 2008: Perform a real-time laboratory demonstration of a radar based air-to-ground moving target algorithm for tactical and reconnaissance platforms. Assess performance against scenarios of interest to the warfighter as would be integrated into candidate radar systems. Provide support to the transition of the moving target algorithm technology to operational strike and reconnaissance platforms as necessary.			

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(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<p>(U) In FY 2009: Continue providing support to the transition of the moving target algorithm technology to operational strike and reconnaissance platforms.</p> <p>(U) MAJOR THRUST: Develop and assess multi-sensor automatic target recognition for intelligence, surveillance, reconnaissance, strike, and weapon systems.</p> <p>(U) In FY 2007: Continued to assess the performance of Air Force and the Defense Advanced Research Projects Agency multi-sensor automatic target recognition fusion algorithms using the Air Force automatic target recognition test and evaluation facility for application to intelligence, surveillance, reconnaissance, strike, and weapon systems. Continued characterizing both single and multiple sensor contributions from radar and electro-optical (including hyperspectral imaging) sensors with automated exploitation. Collected, processed, archived, and distributed research-and-development sensor data for automated exploitation technology development and assessment. Supported automated exploitation technology development and assessment with collaborative computing environment. Completed development of synthetic data generation capability to augment collected research, development, and operational data sets. Augmented the Department of Defense wide repository of research-and-development sensor data with multi-sensor imagery and tracking data collected at warfighter-sponsored exercises. Continued to show impact of automated multi-sensor automatic target recognition and fusion capability in terms of timeline reduction for time-critical targeting to image analysts and decision-makers in the experimental Air Operations Centers. Initiated modeling of existing and emergent sensor systems for assessing automated exploitation technologies in simulated operational environments. Initiated assessment of moving target tracking and identification approaches for multiple sensor types. Initiated evaluation of technology enhancements for post-conflict force protection, stability, and security operations.</p> <p>(U) In FY 2008: Begin spiral development and assessment of multi-sensor automatic target recognition fusion algorithms. Assessment of technology supporting intelligence, surveillance, reconnaissance, strike, and weapon systems will occur in the Air Force automatic target recognition test and evaluation facility. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Critical examination of target, scene and scenario data to determine independence and interdependence of features to support development of an optimum data fusion exploitation capability. Enhance the Air Force automatic target recognition test and evaluation facility and data sets as required to support enhanced automatic target recognition fusion capabilities.</p> <p>(U) In FY 2009: Continue spiral development and assessment of multi-sensor automatic target recognition fusion algorithms. Continued assessment of technology supporting intelligence, surveillance, reconnaissance, strike, and</p>	<p>4.813</p>	<p>3.889</p>	<p>2.141</p>

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

weapon systems using the Air Force automatic target recognition test and evaluation facility. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Develop automatic target recognition fusion sensor data exploitation capability utilizing analysis and experimentation of data independence and interdependence of features to support development of an optimum data fusion exploitation capability. Enhance the Air Force automatic target recognition test and evaluation facility and data sets as required to support enhanced automatic target recognition fusion capabilities. Determine technology shortfalls and develop automatic target recognition fusion technologies to overcome these shortfalls.

(U)

(U) MAJOR THRUST: Develop and demonstrate a moderate-confidence automatic target recognition and advanced cueing capability for stationary and moving targets.

8.370

8.053

6.887

(U) In FY 2007: Further developed high-confidence combat identification capability to determine which combination of sensors, modes, and fusion processing techniques provide a high-confidence combat identification capability for stationary and moving ground targets. Furthered the technology demonstration effort of promising near-term, multi-sensor technologies and fusion processing techniques. Continued critical experiments of advanced multi-sensor, multi-platform technologies and fusion processing techniques for strike and intelligence, surveillance, and reconnaissance assets. Further characterized studies of advanced stationary and moving target multi-sensor data to determine utility for automatic target recognition, automatic target cueing, and combat identification. Further refined tool development to support sensor system, sensor management, and system performance analyses. Continued advanced multi-sensor data collections on stationary and moving targets.

(U) In FY 2008: Develop and evaluate an initial design of multi-sensor fusion algorithms that use change detection techniques to improve target detection and reduce false alarms for higher clutter areas. Develop and evaluate an initial design of a three-dimensional laser-detection-and-ranging automatic target recognition algorithm designed to achieve high confidence identification against targets in various degrees of clutter. Develop and evaluate an initial design of a laser vibrometry algorithm that provide the ability to determine target state (for example, engine on/off) and provide some level of counter denial and deception capability. Develop and evaluate an initial design of a sensor management suite that provides target cue prioritizations and look geometry optimization for three-dimensional laser-detection-and-ranging sensors. Develop and evaluate an initial set of exploitation tools that are optimized for use with three-dimensional laser-detection-and-ranging and laser vibrometry sensors. Enhance automatic target recognition evaluation test facility and data sets as necessary to support program requirements.

(U) In FY 2009: Incorporate improvements in the initial design of the multi-sensor fusion algorithms for improved

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	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<p>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></p> <p>detection that were previously evaluated. Incorporate improvements in the initial design of the three-dimensional laser-detection-and-ranging automatic target recognition algorithms that were previously evaluated. Incorporate improvements in the initial design of the laser vibrometry algorithms that were previously evaluated. Incorporate improvements in the initial design of the sensor management suite that were previously evaluated. Incorporate improvements in the initial set of laser sensor exploitation tools that were previously evaluated. Enhance automatic target recognition evaluation test facility and data sets as necessary to support program requirements.</p>			
<p>(U) MAJOR THRUST: Develop and demonstrate an automatic target recognition capability integrated with advanced georegistration techniques and innovative change detection algorithms.</p>	5.287	2.616	1.386
<p>(U) In FY 2007: Continued to utilize the advanced recognition capability test bed to integrate and upgrade time-critical targeting capability to support the transition to the warfighter of technology products that detect concealed targets and improve ability to dynamically track time-critical targets. Continued development of an autonomous multi-sensor management and data exploitation system supporting an all-weather mission for tactical platforms, including unmanned aerial vehicles. Initiated design and conduct concept demonstration of a concealed target identification sensor and exploitation capability. Initiated the development of an advanced tracking capability that utilizes advanced radar features to fingerprint and associate vehicle observations and integrates multiple radar sensors to maintain continuous track through difficult terrain and in dense traffic.</p>			
<p>(U) In FY 2008: Continue spiral assessment and development of automatic target recognition, automatic target cueing, geo-registration, and change-detection technology. Assess technology supporting time critical targeting systems in the Air Force automatic target recognition test and evaluation facility. Continue spiral development and validation of synthetic data generation capabilities critically needed to augment collected research, development, and operational data sets. Interim demonstration and evaluation of concealed target identification sensing and exploitation technologies. Interim demonstration and evaluation of advanced tracking and multi-sensor track maintenance technology in a militarily significant scenario. Enhance the Air Force automatic target recognition test and evaluation facility and data sets as required to support time-critical targeting capabilities.</p>			
<p>(U) In FY 2009: Determine need to continue spiral assessment and development of automatic target recognition, automatic target cueing, geo-registration, and change detection technology. Continue assessment of technology supporting time critical targeting systems in the Air Force automatic target recognition test and evaluation facility. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Demonstrate time-critical targeting, advanced target tracking and multi-sensor track maintenance capabilities. Enhance the Air Force automatic target recognition test</p>			

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(U) B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
and evaluation facility and data sets as required to support enhanced time-critical targeting capabilities. Determine technology shortfalls and develop emerging time-critical targeting and advanced target tracking technologies to overcome these shortfalls.				
(U) MAJOR THRUST: Develop an "identify friend, foe or neutral" air-to-ground capability using cooperative and non-cooperative identification techniques.		2.610	2.646	2.523
(U) In FY 2007: Finalized design studies and initiate critical experiments to verify improved ground target identification capabilities resulting from ground target database enhancements, identification algorithm enhancements, and advanced radio-frequency tags. Refined advanced identification algorithms and laboratory test with operational sensor data to measure improved confidence and reliability of target identification. Finalized radio-frequency tag design and conducted simulation testing to confirm improved pilot and system operator situation awareness, verify friendly identification confirmations, and performed initial interoperability assessments. Improved exploitation tools to allow automatic screening of large volumes of intelligence, surveillance, and reconnaissance imagery. Developed technology for wide area detection, tracking, and identification against difficult, asymmetric targets at long range. Developed and integrated emerging technologies to enable small unmanned aerial vehicles with electro-optical and infrared sensors to provide persistent intelligence, surveillance, and reconnaissance .				
(U) In FY 2008: Integrate and demonstrate improved ground target identification capabilities through enhanced target databases, identification algorithm advancements and radio-frequency tags in a laboratory environment. Assess maturity of technology via a combination of exercises and scientific analysis by the Air Force automatic target recognition evaluation test facility. Initiate spiral assessment and development of an "identify friend, foe or neutral" air-to-ground capability, enhancing test facilities and target databases as necessary. Plan operational exercise support.				
(U) In FY 2009: Continue to integrate and demonstrate improved ground target identification capabilities through enhanced target databases, identification algorithm advancements and radio-frequency tags in an operational environment. Assess performance of technology to support warfighter integration with operational systems. Continue refinement of identification algorithms and target databases as necessary to support transition of technology.				
(U) MAJOR THRUST: Develop wide angle, continuous staring, multi-sensor/multi-wavelength sensing, and automated exploitation technology that provides detection, tracking and identification of numerous objects of possible military significance over very large ground areas at sensor data update rates. Note: This work is an outgrowth of other work		0.000	5.830	6.000

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PE NUMBER AND TITLE

0603203F Advanced Aerospace
Sensors

PROJECT NUMBER AND TITLE

69DF Target Attack and Recognition
Technology

(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
within this project.			
(U) In FY 2007: Not Applicable.			
(U) In FY 2008: Design and breadboard the individual waveband sensors required to support the persistent staring and automated exploitation capability. Collect data required to support the development, testing and validation of the automated exploitation of the wide-angle, continuous-staring capability. Assess the maturity of the technology through scientific analyses conducted the Air Force automatic target recognition test and evaluation facility.			
(U) In FY 2009: Design and develop engineering model of the multi-sensor, multi-wavelength wide-angle continuously-staring capability building upon the technologies developed during the individual component stage. Integrate and demonstrate the wide-angle, continuously-staring component technologies. Assess the maturity of the technology via a combination of exercises and scientific analyses in the Air Force automatic target recognition test and evaluation facility. Initiate spiral development of wide angle, continuous staring exploitation algorithms, phenomenological modeling, target and scenario databases necessary to support transition to the warfighter. Initiate SAF Interest Item to develop Gotcha Radar, Night Stare, and related electro-optical, infrared, and synthetic aperture radar staring sensor technologies and algorithms.			
(U) MAJOR THRUST: Develop an advanced suite of sensors with automatic target recognition, fusion, and target tracking, all working in concert to provide a high confidence identification capability. Note: This work is an outgrowth of other work within this project.	0.000	0.000	10.861
(U) In FY 2007: Not Applicable.			
(U) In FY 2008: Not Applicable.			
(U) In FY 2009: Design and test an advanced aimpoint tracking capability. Develop and test automatic target recognition capability using electro-optical sensor data. Build upon previous synthetic aperture radar automatic target recognition capability to develop a high-confidence exploitation of synthetic aperture radar data. Develop an advanced capability to fuse information and exploitation results from multiple sensors. Initiate spiral high confidence identification development of algorithm phenomenological modeling, target and scenario databases necessary to support technology development. Assess maturity of technology during the spiral process via the Air Force automatic target recognition test and evaluation facility and other sensor test facilities.			
(U) CONGRESSIONAL ADD: National Operational Signature Production and Research Capability (Combat Identification Signature Center).	1.395	0.000	0.000
(U) In FY 2007: Conducted Congressionally-directed effort for National Operational Signature Production and Research			

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BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 69DF Target Attack and Recognition Technology
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(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Capability (Combat Identification Signature Center).			
(U) In FY 2008: Not Applicable.			
(U) In FY 2009: Not Applicable.			
(U)			
(U) CONGRESSIONAL ADD: Active Unmanned Air Vehicle (UAV) Phenomenology (AUP) & ART Technology Transition.	0.000	3.974	0.000
(U) In FY 2007: Not Applicable.			
(U) In FY 2008: Conduct Congressionally-directed effort for Active Unmanned Air Vehicle (UAV) Phenomenology (AUP) & ART Technology Transition.			
(U) In FY 2009: Not Applicable.			
(U)			
(U) Total Cost	27.015	32.220	30.130

(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>Cost to Complete</u>	<u>Total Cost</u>
	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>		
(U) Related Activities:									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0603253F, Advanced Sensor Integration.									
(U) PE 0603500F, Multi-Disciplinary Advanced Space Technology.									
(U) PE 0603762E, Sensor and Guidance Technology.									
(U) PE 0603270F, Electronic Combat Technology.									
(U) Theater Missile Defense System Program Office.									
(U) Low Altitude Night Targeting and Infrared Navigation									

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Sensors**

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**69DF Target Attack and Recognition
Technology****(U) C. Other Program Funding Summary (\$ in Millions)**

(LANTIRN) System Program
Office.

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

(U) D. Acquisition Strategy

Not Applicable.

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BUDGET ACTIVITY 03 Advanced Technology Development (ATD)				PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors			PROJECT NUMBER AND TITLE 88SP Advanced Space Sensors		
Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
88SP Advanced Space Sensors	11.727	12.232	10.244	6.658	6.807	8.112	7.811	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0		

Note: In FY 2007, efforts were transferred from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5034, Advanced Space Sensors, in order to more effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This project develops and demonstrates space sensor technologies, including radio frequency sensors; intelligence, surveillance, and reconnaissance sensors; electro-optical sensors; laser warning sensors; targeting and attack radar sensors; and electronic counter-countermeasures and communications. By developing multi-function radar, laser, electronic combat, and electronic counter-countermeasures technologies for space applications, this project provides space platforms with the capability to precisely detect, track, and target air- and ground-based, high-value, time-critical targets, while remaining invulnerable to hostile and natural threats.

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

	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) MAJOR THRUST: Reduce technology risk for space sensor platform payload components and exploitation of infrastructure integration.	0.698	0.452	0.842
(U) In FY 2007: Integrated space-sensor technologies into a complete radar payload simulation test bed with selected hardware in the loop and demonstrate system design feasibility.			
(U) In FY 2008: Develop approach to design responsive space payload capabilities while retaining hardware implementation feasibility. Define payload to bus satellite interface requirements and standards.			
(U) In FY 2009: Develop "plug-and-play" satellite critical experiment, to including full simulation.			
(U) MAJOR THRUST: Develop and demonstrate technologies to maximize global positioning system jam resistance, positional accuracy, timing accuracy, and exploitation techniques to improve offensive and defensive combat capabilities.	1.079	1.289	2.200
(U) In FY 2007: Developed space-based distributed position, navigation, and timing technologies to detect, identify and locate global positioning system threats. Developed multi-ship virtual flight test simulation technology to assess networked clusters of unmanned aerial vehicles, intelligence, surveillance, and reconnaissance platforms, and space-based platforms.			
(U) In FY 2008: Demonstrate space-based distributed position, navigation, and timing technologies to detect, identify, and locate global positioning system threats. Demonstrate multi-ship virtual flight test simulation technology to assess networked clusters of unmanned aerial vehicles, intelligence, surveillance, and reconnaissance platforms, and space-based platforms.			
(U) In FY 2009: Design space-based distributed position, navigation, and timing technologies to achieve optimal sensor			

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	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>			
fusion for space situational awareness. Design multi-ship virtual flight test simulation technology to assess world-wide distributed position, navigation, and timing architectures for disparate platforms for space situational awareness.			
(U) MAJOR THRUST: Develop electro-optical sensor component technology to advance multiple space mission areas. Develop new sensor components, topologies and architectures for space.	1.578	1.610	1.520
(U) In FY 2007: Fabricated advanced space environment phenomenology sensor components.			
(U) In FY 2008: Conduct experimental space flight of sensor components to test in space environment. Initiate data collection, testing and system evaluation with relevant space environment phenomenology.			
(U) In FY 2009: Complete experimental space flight of sensor components to test in space environment. Complete data collection, testing and system evaluation. Initiate lab-based integration testing with embedded satellite components.			
(U) MAJOR THRUST: Develop advanced laser communication component and sub-system technology to support a network-level topology for airborne intelligence, surveillance, and reconnaissance	5.000	6.349	5.000
(U) In FY 2007: Began development of an integrated wideband radio-frequency/electro-optical communication terminal and shared-aperture antenna for evaluation and testing in an air-network layer. Continued development of technologies for radio-frequency/electro-optical shared apertures to service high-bandwidth communication needs. Continued testing applicability of shared apertures to maintaining air-network link connectivity under adverse weather conditions. Expanded flight demonstrations of radio-frequency, optical, and combined radio-frequency/optical communication terminal technologies for air-network layers.			
(U) In FY 2008: Continue development of an integrated wideband radio-frequency/electro-optical communication terminal and shared aperture antenna. Begin evaluation and testing of the integrated terminal and antenna in an air network layer. Begin maturation of technologies for integration into communication architecture. Continue flight demonstrations of radio-frequency, optical, and combined radio-frequency/optical communication terminal technologies for air-network layers.			
(U) In FY 2009: Continue maturation of technologies for integration into airborne network architecture. Conduct ground and flight tests of laser communication system. Develop the advanced free space optical modem focusing on compact packaging for airborne terminal rack rack installations. Integrate optical terminal with radio-frequency communications gear to enable testing of hybrid free space optical and radio-frequency communications terminal for intelligence, surveillance, and reconnaissance relay missions. Demonstrate hybrid free space optical/radio-frequency failsafe/failback operations in airborne tests. Note: this effort ends in FY09.			

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(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) MAJOR THRUST: Develop and demonstrate a geodesic phased array antenna to achieve enhanced satellite operations over current reflector antennas. Improve operational capacity and efficiency to support satellite control network.	3.372	2.532	0.682
(U) In FY 2007: Analyzed system requirements and complete the design of the multi-beam geodesic dome phased array antenna. Finalized radio-frequency and mechanical designs of the geodesic dome panels to demonstrate critical performance characteristics. Completed evaluation of the transmit/receive modules, the radiating element, beam former array panels, and the antenna resource manager computer.			
(U) In FY 2008: Fabricate transmit/receive modules, radiating elements, beam former array panels for the geodesic phased array antenna dome sub-sector to be used in the advanced technology demonstration.			
(U) In FY 2009: Fully characterize the advanced technology demonstrator sub-sector and demonstrate with operational satellites.			
(U) Total Cost	11.727	12.232	10.244

(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>Cost to</u>	<u>Total Cost</u>
	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	
(U) Related Activities:									
(U) PE 0602204F, Aerospace Sensors.									
(U) PE 0602500F, Multi-Disciplinary Space Technology.									
(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.									
(U) PE 0603270F, Electronic Combat Technology.									
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.									

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88SP Advanced Space Sensors

(U) D. Acquisition Strategy

Not Applicable.