RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 2002	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development				R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, R-1 #49					
COST *(In Millions)*	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost To Complete	Total Cost
Total Program Element (PE) Cost	138.508	192.095	224.000	216.840	200.430	200.191	200.742	Continuing	Continuing
Guidance Technology SGT-01	20.212	37.401	44.000	48.704	54.536	56.407	65.186	Continuing	Continuing
Aerospace Surveillance Technology SGT-02	23.142	23.732	28.000	24.849	24.789	24.792	19.753	Continuing	Continuing
Air Defense Initiative SGT-03	21.236	24.155	31.000	37.770	30.738	28.792	24.938	Continuing	Continuing
Sensors and Exploitation Systems SGT-04	73.918	106.807	121.000	105.517	90.367	90.200	90.865	Continuing	Continuing

(U) Mission Description:

(U) The Sensors and Guidance Technology program element is budgeted in the Advanced Technology Development Budget Activity because it is developing the system oriented technologies necessary to enhance sensor and weapon system accuracy and capability to meet current and emerging threats. Four projects are funded in this program element: Guidance Technology, Aerospace Surveillance Technology, the Air Defense Initiative, and Sensors and Exploitation Systems.

(U) The Guidance Technology project is leveraging geolocation technologies to enhance the navigation and/or guidance packages of airborne platforms, ground vehicles and weapons. These improved systems will improve the accuracy and effectiveness of stand-off weapons, minimizing collateral damage while reducing the cost-per-kill.

(U) Aerospace Surveillance Technology programs are developing technologies to improve the accuracy and timeliness of surveillance systems in all weather, in hostile reception environments, and when necessary, in a covert manner. The programs funded by this project exploit recent advances in multispectral target phenomenology, signal processing, lower power high performance computing and low cost microelectronics technologies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, R-1 #49

(U) The Air Defense Initiative is an on-going project whose overall goal is to counter advanced battlefield threats and enhance the survivability of U.S. assets in the face of enemy electronic countermeasures.

(U) The objective of the Sensors and Exploitation Systems project is to provide the warfighter with situational awareness and battlefield dominance by developing key sensor technologies; providing near-real-time semi-automatic exploitation of wide-area moderate (and high) resolution imagery data; providing real-time and accurate battlefield assessment; and robust, precise and reliable identification, precision fire control tracking and engagement of high value units and critical moving targets.

(U) **Program Change Summary:** (*In Millions*)	**FY2001**	**FY 2002**	**FY 2003**
FY02 Amended President's Budget	139.858	203.095	178.715
Current Budget	138.508	192.095	224.000

(U) Change Summary Explanation:

FY 2001 Decrease reflects the SBIR reprogramming and minor program realignments.

FY 2002 Decrease reflects congressional program reduction partially offset by the Large Millimeter Wavelength Telescope congressional add.

FY 2003 Increase reflects increased Agency emphasis on precision weapon targeting and tracking, and expanded funding for sensor data exploitation.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-01

COST *(In Millions)*	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Guidance Technology SGT-01	20.212	37.401	44.000	48.704	54.536	56.407	65.186	Continuing	Continuing

(U) Mission Description:

(U) Fire-and-forget standoff weapons need precise targeting information if critical fixed and mobile targets are to be eliminated effectively with minimal collateral damage and minimum cost-per-kill. This requires that: (1) military surveillance and targeting systems geolocate targets accurately in the same coordinate system in which the weapon system navigates; (2) the surveillance, targeting and weapon systems have precision navigation and guidance systems on-board; and (3) navigation and target location systems robustly operate day/night and in adverse weather. In addition, future systems designed to accomplish precision strike missions must be significantly more affordable. The achievement of these characteristics in an integrated system is the goal of this program. Thrusts are included in this project to increase the ability of Global Positioning System (GPS) users to operate effectively in presence of enemy jamming; to increase the versatility of navigation systems applications by developing micro electromechanical sensor inertial navigation system technologies; and to apply the geolocation technologies/techniques to precision threat geolocation of short-dwell emitters or passive air defense systems.

(U) The Global Positioning Experiments (GPX) program will increase the ability of GPS users to operate effectively in the presence of enemy jamming or countermeasures. It will demonstrate feasibility of airborne pseudolite (APL) concepts, which would sustain the availability of GPS signals to users in the presence of enemy jamming. The considerably increased transmit power of the APL fights off the effects of jamming on DoD receivers. APLs can be rapidly deployed on unmanned aerial vehicles (or other airborne platforms) and provide theater-wide coverage for individual soldiers, combat platforms and precision GPS-guided shoot-to-coordinate weapons. The program addresses three key challenges. First, it demonstrates non-Keplerian orbit predictions of the APL and shows that only software modifications are needed for GPS user receivers. Second, the APL must also accurately navigate using GPS satellites in the presence of jamming. Accordingly, this program provides for the design, development and demonstration of a low cost, space-time adaptive beamforming anti-jam receive antenna and a digital adaptive beamformer. With advanced algorithms, this will support greater than 45 dB nulls against up to six different jammers. Third, it is necessary to minimize the impact on friendly, unmodified receivers and maximize interoperability. Advanced waveforms, demonstration of an advanced beam shaping transmit antenna, precise management of the radiated power, and the associated command and control structure will therefore be developed. The GPX program will culminate with integrated demonstrations of APL capability in military exercises.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-01

(U) The Microelectromechanical Sensor Inertial Navigation System (MEMS INS) program will improve the silicon based, inertial sensors (gyros and accelerometers) developed in the MEMS technology program and integrate them with navigation software into a low power, small, light weight, low cost, tactical grade (1.0 degree per hour to 10 degrees per hour drift rate) INS. In addition to handheld applications, the MEMS INS will be generic for insertion/embedding into other military systems. MEMS INS Phase 1 performed the following: (1) design and development of higher performance MEMS inertial gyroscope and accelerometer sensors, (2) selection and refinement of foundries/foundry processes, (3) design of the mechanical subsystem, and (4) selection/refinement of the navigation software. Phase 2 will develop the MEMS inertial sensors brassboard, integrate them into a MEMS INS and demonstrate the brassboard in the field. Three prime contractors are proceeding in Phase 2. Technologies also are being developed for mesoscale gyros. These will be designed, developed and tested at the gyro level. Subsequently, a triad of meso gyros will be integrated and demonstrated as a meso inertial measurement unit. The MEMS and Meso technologies will be evaluated for suitability to space applications.

(U) The Advanced Tactical Targeting Technology (AT3) program will demonstrate a passive tactical targeting system against short-dwell emitters for the lethal suppression of enemy air defenses (SEAD). The targeting system must negate emitter shutdown tactics now employed to defeat Anti-Radiation Missles (ARM) guidance and enable simplified ordnance inventories. Generation and distribution of near real-time (e.g., seconds) comprehensive, and highly precise location of threat radars to all theater combatant aircraft is required without deploying any extra, SEAD dedicated, emitter-collecting platforms. AT3 will accomplish this by widely deploying emitter collection packages hosted on existing airborne platforms, including combatant aircraft. AT3 will integrate in real-time the distributed multi-platform emitter collections using existing or planned tactical data links with advanced network management and signal processing. Additionally, to achieve the necessary wide deployment, AT3 will transition to the Services either as self-contained affordable collection packages or via inexpensive digital upgrades to existing radar warning receivers. Enabling technologies now in development at DARPA and elsewhere will be used, including: highly precise tactical clocks; tightly coupled integrated GPS/INS packages; novel communications waveforms; advanced highly dynamic data fusion network management capabilities; and algorithms to ensure robust, flexible performance of geolocation algorithms for locating multiple emitter types in noisy, high pulse density environments.

(U) The Multifunction Electro-Optics for Defense of U.S. Aircraft (MEDUSA) program will develop the technologies and systems to give the U.S. air dominance at low altitude and at night. This program will develop the technologies to leap-frog reactive end game countermeasures and enable increased threat warning times, denial of launch, and put EO-IR air defense threats at risk. MEDUSA is a three-part technology program: (1) conduct phenomenological measurements and develop countermeasures and target classification/identification techniques; (2) develop critical

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-01

component technologies such as high power IR laser sources, advanced IR detectors, and fibers for high power IR transmission; and (3) competitively develop and demonstrate an end-to-end MEDUSA system.

(U) Program Accomplishments and Plans:

(U) FY 2001 Accomplishments:

- Global Positioning Experiments (GPX). ($3.975 Million)
  - Completed development and evaluation of elements of the pseudolite network.
  - Completed lab and initial field demonstrations of a digital adaptive beamformer with multi-element antenna.

- Microelectromechanical Sensor Inertial Navigation System (MEMS INS). ($4.387 Million)
  - Evaluated brassboard sensors and electronics.

- Advanced Tactical Targeting Technology. ($11.850 Million)
  - Completed fabrication and began ground tests.
  - Initiated advanced algorithm development.
  - Completed study of EO/IR surface-to-air-missile fire control targeting.

(U) FY 2002 Plans:

- Global Positioning Experiments (GPX). ($8.000 Million)
  - Complete demonstration of digital adaptive beamformer integrated with pseudolite in a GPS jamming environment.
  - Initiate fabrication of multiple airborne pseudolites.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-01

- Microelectromechanical Sensor Inertial Navigation System (MEMS INS). ($5.000 Million)
  - Deliver MEMS inertial measurement unit to the Government.
  - Complete field demonstration of MEMS INS navigation capabilities.
  - Demonstrate meso gyro with 1 degree per hour performance.
  - Investigate novel INS designs for very large structures that exploit large baseline separation.
  - Investigate MEMS and Meso suitability to space applications.

- Advanced Tactical Targeting Technology. ($13.401 Million)
  - Complete ground tests.
  - Initiate strenuous flight tests and real-time multi-ship demonstrations.

- MEDUSA. (11.000 Million)
  - Develop and evaluate MEDUSA countermeasure and classification techniques and conduct phenomenological measurements.
  - Initiate critical component and system technology development.

(U) **FY 2003 Plans:**

- Global Positioning Experiments (GPX). ($9.500 Million)
  - Complete airborne pseudolite fabrication and integration.
  - Conduct airborne testing campaign; demonstrate successful navigation and interoperability in GPS jamming environment using multiple airborne pseudolites.

- Microelectromechanical Sensor Inertial Navigation System (MEMS INS). ($6.000 Million)
  - Develop an inertial measurement unit based on meso gyro technology.
  - Conduct preliminary meso gyro navigation tests.
  - Begin system design for user (Service) test.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-01

- Advanced Tactical Targeting Technology. ($10.500 Million)
  - Complete experimental data analysis.
  - Complete field demonstrations.

- MEDUSA. ($18.000 Million)
  - Complete measurements database and development of countermeasures and classification techniques.
  - Fabricate and evaluate critical component technologies.
  - Develop MEDUSA system designs.

(U) Other Program Funding Summary Cost:

- Not Applicable.

(U) Schedule Profile:

Plan	Milestones
Feb 02	Complete laboratory demonstration of MEMS INS operations.
Apr 02	Complete AT3 ground tests.
Jul 02	Demonstrate meso gyro performance.
Jun 02	Complete field test/demonstration of MEMS IMU.
Jul 02	Demonstrate GPX airborne pseudolite operation with digital beamformer in GPS jamming.
Dec 02	Complete AT3 real-time flight tests.
Jul 03	Complete design of meso IMU.
Jun 03	Demonstrate an integrated GPX pseudolite system with weapons in jamming environments.
Aug 03	Complete AT3 data analysis and field demonstrations.
Sep 03	Complete MEDUSA measurements database and system designs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 2002	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development				R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-02					
COST *(In Millions)*	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Aerospace Surveillance Technology SGT-02	23.142	23.732	28.000	24.849	24.789	24.792	19.753	Continuing	Continuing

(U) Mission Description:

(U) This project funds sensor efforts that will improve the accuracy and timeliness of our surveillance and targeting systems for improved battlefield awareness, strike capability and battle damage assessment. Timely surveillance of enemy territory under all weather conditions is critical to providing our forces with the tactical information needed to succeed in future wars. This operational surveillance capability must continue to perform during enemy efforts to deny and deceive the sensor systems, and operate, at times, in a covert manner. This project will exploit recent advances in multispectral target phenomenology, signal processing, low-power high-performance computing, and low-cost microelectronics to develop advanced surveillance and targeting systems. Surveillance is not an end to itself, but rather an enabler for force protection and precision strike. Therefore, a key component of this program is the development of a comprehensive sensor-to-shooter architecture.

(U) The Digital Radio Frequency Tags program will develop a flexible, potentially low cost technology to allow radars (Moving Target Indicator (MTI) and Synthetic Aperture Radar (SAR)) to receive data from ground devices. This program will develop a small, lightweight and affordable RF Tag for data exfiltration from unattended ground sensors and communication with vehicles and personnel throughout the battlespace. This is particularly useful for the identification and location of coalition units. Additionally, the Digital RF Tag capability can be exploited for other missions, with the net effect of substantially enhancing situational awareness and combat identification advantages for U.S. forces in conventional and unconventional ground operations.

(U) Underground Facilities (UGFs) are being increasingly employed to hide a variety of strategic functions, including command and control and activities associated with weapons of mass destruction. The Counter-Underground Facilities (CUGF) program will develop technologies to characterize UGFs: identification of facility function, UGF pace of activity, pre-attack status of the facility, trans-attack activities and post-attack status. Techniques will be developed to determine locations of critical systems (power, water, airflow vents), orientation and depth of structure, and pre-strike and post-strike changes in the substructure resulting from attack. Additionally, techniques will be developed for effluent detection and monitoring. Candidate technologies include, but are not limited to, low frequency electromagnetics, multi/hyperspectral imaging, seismic imaging, chemical sampling, and coherent passive seismic, acoustic and electromagnetic monitoring. A companion effort, the Tactical Missile – Penetrator (TACM-P) program, will demonstrate integration of the Army Tactical Missile System (ATACMS) booster with a Navy reentry vehicle to provide a

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-02

high-availability, all-weather, survivable and short response time means to destroy hard and deeply-buried targets. U.S. Pacific Command is the operational sponsor.

(U) The Space Surveillance Telescope program will develop and demonstrate an advanced ground-based optical system to enable detection and tracking of faint objects in space, while providing rapid, wide-area search capability. The program will leverage recent advances in curved focal plane array technology and large, light-weight optics to build a telescope with a large aperture that provides detection sensitivity with a low-aberration wide field-of-view to provide rapid wide-area search coverage. Advances in lightweight optics will reduce the size and weight of the telescope, providing fast slewing and further increasing search rates. This capability will enable ground-based detection of un-cued objects in space for purposes such as asteroid detection and other defense missions. In FY 2003, this program will be funded from PE 0603285E, Project ASP-02, Space Programs and Technologies.

(U) The Near-Nadir MMW Exploitation System (NEMESYS) will detect and identify targets under trees using an ultra-high resolution, 3D Ka-band SAR flown on a small UAV. By imaging at steep grazing angles, foliage penetration losses and phase perturbations at millimeter wave frequencies are minimized. Three-dimensional images are formed by using a combination of wide bandwidth waveforms to obtain height resolution, conventional SAR to provide along-track resolution, and a virtual SAR created by activating sequential elements of a linear array to provide cross-track resolution. Multiple images of the target are formed to allow 3D rendering. Target scatterer locations are correlated with 3D CAD models to provide a simple, robust and inexpensive form of ATR.

(U) The Large Millimeter Wave Telescope (LMT) program is the U.S.-complement to a coordinated U.S.-Mexico project. The DARPA program is providing technology assessments for design, systems integration and technology-leading metrology for a 50-meter aperture, fully steerable millimeter wave radio telescope. The fully developed telescope features a sophisticated laser metrology system to maintain precise alignment of the optics, and real-time closed loop adaptive control to maintain a near-perfect parabolic surface at all pointing angles and under most environmental conditions.

(U) Program Accomplishments and Plans:

(U) FY 2001 Accomplishments:

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-02

- Digital Radio Frequency (RF) Tags. ($7.998 Million)
  - Completed critical design review (CDR) for digital RF tag.
  - Completed definition of message embedding and extraction algorithms.
  - Conducted component risk reduction tests on brassboard system.

- Counter-Underground Facilities. ($11.144 Million)
  - Completed baseline models of signatures and backgrounds for passive acoustic, seismic, electromagnetic (PASEM), and effluents observables.
  - Initiated model validation experiments.
  - Completed modeling tools for evaluation of effluent based vent hunting.
  - Completed preliminary validation experiments for vent effluent denial & deception simulation tools.
  - Initiated interface requirements definition and initiated hardware/software design for the Tactical Missile – Penetrator (TACM-P).

- Large Millimeter Telescope. ($4.000 Million)
  - Completed detector/pointing system baseline controls.
  - Completed telescope critical design review.
  - Completed foundation and deep support piles.
  - Completed fabrication of Azimuth component track and pintle bearing.

(U) **FY 2002 Plans:**

- Digital Radio Frequency (RF) Tags. ($5.600 Million)
  - Perform software design, coding and test.
  - Complete tag breadboard unit.
  - Conduct laboratory device testing and characterization.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-02

- Counter-Underground Facilities. ($12.532 Million)
  - Complete model validation for seismic, acoustic, electromagnetic and effluent signatures and backgrounds.
  - Complete hardware/software design and initiate missile re-entry body system tests of the Tactical Missile – Penetrator (TACM-P).
  - Complete interface definition and continue hardware/software design for the Tactical Missile – Penetrator (TACM-P).
  - Initiate design for passive acoustic, seismic, electromagnetic (PASEM) functional prototype demonstration (non-form factored).
  - Initiate concept development for low-mass, seismic coupling of vibration sensors, site-adaptive non-line of sight communications, and improved deployable EM sensors.
  - Complete validation of effluents modeling tools.
  - Initiate concept evaluation for specific techniques for effluent based vent hunting.

- Space Surveillance Telescope. ($4.100 Million)
  - Complete telescope design.
  - Complete focal plane design.
  - Fabricate and test first curved focal plane tile.

- Large Millimeter Telescope. ($1.500 Million)
  - Initiate fabrication of metrology panel and surface.
  - Initiate antenna holography system.
  - Initiate precision pointing.

(U) **FY 2003 Plans:**

- Digital Radio Frequency (RF) Tags. ($5.500 Million)
  - Complete tag prototype units.
  - Conduct airborne field tests and user demonstration.
  - Develop low frequency RF tags for use under foliage.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-02

- Counter-Underground Facilities. ($12.500 Million)
  - Complete passive acoustic, seismic, electromagnetic (PASEM) functional prototype system demonstration design and hardware integration.
  - Evaluate performance of low-mass, seismic coupling concepts for vibration sensors (rock, loose rock, unconsolidated soils).
  - Conduct pairwise nodal evaluation of site-adaptive non-line of sight communication concepts; make Go/NoGo Decision for multimode development.
  - Evaluate improved deployable EM sensors: noise performance for small devices, self orientation and calibration algorithms; make Go/NoGo Decision for deployable sensor completion.
  - Complete concept definition for effluent based vent hunting and initiate prototype design.

- Near-Nadir MMW Exploitation System (NEMESYS). ($10.000 Million)
  - Conduct antenna proof of principle study.
  - Measure 1-D synthetic aperture signatures of canonical targets through canopy.
  - Begin development of target and clutter models.
  - Begin development of signal processing, visualization tools and automatic target recognition algorithms.

(U) **Other Program Funding Summary Cost:** *(In Millions)*

	FY 2001	FY 2002	FY 2003
Tactical Missile – Penetrator (TACM-P):			
Source			
OSD/ASCE PE 0603750D8Z	4.300	6.600	7.500

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-02

(U) Schedule Profile:

Plan	Milestones
Digital Radio Frequency (RF) Tags:	
Nov 02	Prototype RF tag component hardware fabrication and testing complete.
May 03	Prototype digital tag testing complete.
Sep 03	Field test of prototype tag.
Counter-Underground Facilities:	
Sep 02	Complete passive acoustic, seismic, electromagnetic (PASEM) functional prototype/demonstration system design.
Sep 02	Complete hardware/software design for re-entry body. Conduct CDR and initiate flight hardware fabrication.
Sep 03	Complete PASEM functional prototype system integration.
Near-Nadir MMW Exploitation System (NEMESYS):	
Oct 02	Initiate target and clutter measurement and modeling efforts.
Oct 02	Initiate development of signal processing, visualization tools, and ATR algorithms.
Jun 03	Conduct Preliminary Design Reviews (PDR).

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 2002	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development				R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-03					
COST *(In Millions)*	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Air Defense Initiative SGT-03	21.236	24.155	31.000	37.770	30.738	28.792	24.938	Continuing	Continuing

(U) Mission Description:

(U) This project encompasses several advanced technologies related to the development of techniques to counter advanced battlefield threats. These technology developments are embodied in the Low-Cost Cruise Missile Defense (LCCMD), Global Eye, Affordable Large-Scale Array (ALSA), Innovative Space-Based Radar Antenna Technology (ISAT) Study and Polarized Infrared Imaging Seeker (PIRIS) programs.

(U) The LCCMD program will design, develop, demonstrate and transition an affordable seeker for use on a missile interceptor system to defeat unsophisticated air vehicles. Unsophisticated air vehicles are affordable, can be procured in large numbers to overwhelm U.S. defenses and provide a credible long-term threat to both civilian population centers and military targets. To reduce the cost of defending against such threats, it is crucial to reduce the cost of the guidance and control sections of defensive weapons. The LCCMD program will enable this through analyses, laboratory testing and field-testing of an all-weather seeker costing less than fifty thousand dollars in production. The program has pursued six novel concepts and is presently focused on the maturation and demonstration of radar seeker solutions employing MEMS phase shifters and novel waveforms. In addition, the program is examining low-cost surveillance strategies to provide the warning/cue for such interceptors.

(U) The Global Eye program is developing lightweight low-cost electronically scanned array (ESA) technology that is capable of supporting multiple simultaneous radar modes and frequencies through the use of mono-static or pseudo-mono-static apertures operating in a simultaneous transmit and receive (STAR) mode. Platforms outfitted with this capability could provide lower cost continuous air and ground surveillance of low intensity areas such as no-fly zones and peacekeeping areas. Such capability could supplement traditional AWACS and JSTARS and potentially reduce the requirement to forward base large numbers of such aircraft for these purposes. The key technologies being developed include a proof-of-concept ESA risk reduction array capable of supporting a 100% transmit duty factor using currently available transmit/receive (T/R) modules, beam polarization diversity, and advanced mode control/interleaving algorithms.

(U) The Affordable Large-Scale Array (ALSA) (previously the MEM-tenna program) is developing ultra-low cost, lightweight, and low-power density X-Band antenna technologies and components for use in large-scale phased array antennas. MEMS and other alternative low-power-module technologies can be used to produce phased array antenna components that consume a small fraction of the power currently needed by conventional phased arrays, while being considerably lighter weight. It may also be possible to replace hard-wired beam steering control and RF

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-03

manifolds by optical and RF space-fed configurations which will result in significant savings in cost and weight. Using these technologies, very large-scale electronically scanned arrays (ESAs) can be developed for multiple airborne and surface-based surveillance missions, including homeland defense against air threats.

(U) Ultra-low cost, lightweight technologies offer the potential for developing and deploying extremely large antennas in space. Antennas of 100 – 300 sq meters, if feasible and affordable, will enable the revolutionary performance required to conduct true tactical sensing from space. In FY 2002, a one-year, multi-contractor project (ISAT – Innovative Space-Based Radar Antenna Technology) will be conducted to assess and produce feasible and affordable candidate extremely-large-antenna designs capable of performing tactical sensing from space. Follow-on activities for ISAT activities are funded in Program Element PE0603285E, Project ASP-02.

(U) The polarized infrared imaging seeker (PIRIS) program will develop and demonstrate a prototype seeker with an extremely sensitive degree-of-polarization measurement capability to allow for separation of real targets from emerging infrared countermeasures (IRCM) technologies. Current imaging systems rely on spatial, spectral and temporal resolution to separate enemy countermeasures from the target skin return. New ECM technologies, such as activated metal decoys (AMDs), pose significant challenges to systems relying on spatial, spectral and temporal resolution. AMDs provide a spatially distributed source at appropriate temperatures to thwart these conventional approaches. The PIRIS program will develop and demonstrate the technologies required to buy back performance against AMDs using polarization diversity. The PIRIS program will conduct a series of experiments to verify the degree-of-polarization separation of multiple types of countermeasures and targets and will culminate in a captive carry flight test of an advanced polarized seeker capable of defeating the entire range of emerging IRCM threats.

(U) Program Accomplishments and Plans:

(U) FY 2001 Accomplishments:

- LCCMD. ($11.768 Million)
  - Completed laboratory characterization testing of eye-safe LADAR seeker.
  - Designed, fabricated and tested improved RF MEMS capacitive and contact switches for use in MEMS antenna array.
  - Completed noise radar seeker China Lake field-testing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-03

- Global Eye. ($3.275 Million)
  - Initiated and completed proof-of-concept studies on the design and fabrication of MEMS-based filters that could be used to facilitate the use of simultaneous transmit and receive (STAR) waveforms.
  - Began risk reduction phased array fabrication and tests.
  - Developed initial concepts and system architectures for advanced radar mode control using a pseudo-mono-static aperture for STAR operation.

- ALSA. ($5.193 Million)
  - Completed fabrication and evaluation of 100 prototype MEMS 2-bit phase shifters from three contractors.
  - Completed follow-on MEMS phase shifter design studies.
  - Conducted trade studies for array calibration techniques with both specific and general applicability.
  - Initiated MEMS lifetime and reliability improvement effort.
  - Initiated efforts to investigate and analyze alternative phased array antenna technologies, including SiGe, InP, and Si on insulator, and low-power GaAs, as potential alternatives for low-cost/low-power density phased array antenna operations.

- Advanced Sensing Alternatives. ($1.000 Million)
  - Explored advanced sensing modalities to solve stressing combat ID and countermeasure challenges, including, but not limited to, polarization diversity and unconventional operating frequencies.

(U) **FY 2002 Plans:**

- LCCMD. ($12.000 Million)
  - Complete noise radar seeker data analysis final report.
  - Conduct MEMS ESA seeker systems requirements and preliminary design reviews.
  - Fabricate and test packaged RF MEMS for use in MEMS antenna array.
  - Initiate MEMS modeling effort and MEMS design improvement/packaging studies for enhanced reliability RF MEMS switches.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-03

- Conduct studies on low-cost surveillance approaches to supply required threat warning. Determine feasibility of exploiting existing infrastructure, such as cell towers.

- Global Eye. ($1.705 Million)
  - Demonstrate pseudo-mono-static ESA operation using a 1 sq ft risk reduction array.
  - Use the prototype ESA risk reduction array to evaluate its ability to support multiple-mode, multiple-frequency, and radar operation during ground testing with a Moving Target Simulator (MTS) and a mechanically scanned receive aperture.

- ALSA. ($3.450 Million)
  - Conduct studies and experiments to develop alternative array feed technologies that are applicable to very large arrays.
  - Continue investigation and evaluation of alternate solutions, e.g., SiGe, InP, Si on insulator, and low-power GaAs, as potential low cost/low power density phased array antenna technologies.
  - Conduct power-aperture trade studies to determine the appropriateness of these technologies for applications including ground-based or airborne low-power-density, large-scale antennas for homeland defense.
  - Develop and fabricate a minimum of 10 transmit/receive (T/R) cells for independent test and evaluation.

- ISAT. ($6.000 Million)
  - Develop detailed conceptual designs of multiple antenna systems.
  - Develop performance and cost models for each candidate design and associated technologies.
  - Identify critical technologies and risk reduction requirements.
  - Model and simulate rigidized inflatable technologies.

- PIRIS. ($1.000 Million)
  - Conduct field experiments to verify degree-of-polarization separation of targets and infrared countermeasures.
  - Initiate polarized seeker component technology studies and development.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-03

(U) FY 2003 Plans:

- LCCMD. ($17.000 Million)
  - Conduct MEMS ESA seeker critical design review.
  - Fabricate and test MEMS ESA seeker antenna.
  - Fabricate MEMS ESA seeker back-end.
  - Initiate procurement of long-lead items for captive flight test (in collaboration with service transition partner).
  - Conduct iterative design, fabrication and testing of advanced RF MEMS designs for EMD-quality RF MEMS switches.
  - Initiate systems design for low-cost surveillance approaches.
  - Initiate field measurements to support performance characterization of surveillance systems.
  - Conduct small-scale feasibility demonstration.

- ALSA. ($10.000 Million)
  - Develop system-level conceptual designs for low-power-density surveillance applications.
  - Estimate system-level performance achievablefor low power density surveillance applications.
  - Initiate risk reduction activities for these designs, including deployment/unfolding technologies appropriate to large-scale structures.

- PIRIS. ($4.000 Million)
  - Conduct critical hardware risk reduction experiments.
  - Conduct preliminary design of prototype-polarized seeker.

(U) Other Program Funding Summary Cost:

- Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-03

(U) Schedule Profile:

Plan	Milestones
LCCMD:	
Aug 02	Complete systems requirements and preliminary designs.
Feb 03	Conduct MEMS ESA seeker critical design review.
Apr 03	Complete system-level conceptual designs for low-cost surveillance systems.
Sep 03	Complete EMD quality RF MEMS switch design, fabrication and test.
Sep 03	Complete estimation of system-level performance for surveillance approaches.
Sep 03	Complete initial feasibility demonstration.
Oct 03	Start MEMS ESA seeker antenna test.
Global Eye:	
Apr 02	Complete fabrication of a basic ESA risk reduction array and begin testing of the array.
Aug 02	Complete pseudo-mono-static multiple frequency multiple-mode demonstrations using the risk reduction array.
ALSA	
Mar 02	Begin fabrication of a minimum of 10 T/R cells.
Jun 02	Conduct testing of 10 T/R cells.
Apr 03	Complete system-level conceptual designs.
Sep 03	Complete estimation of system-level performance.
Sep 03	Demonstrate deployment of large structure.
ISAT:	
May 02	Preliminary conceptual designs.
Jun 02	Preliminary large aperture control and calibration analysis.
Sep 02	High-fidelity steady state and dynamic models of rigidized inflatable designs.
Sep 02	Complete conceptual designs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-03

Oct 02 Conceptual design presentations and supporting analysis.

PIRIS:

Sep 02 Complete degree-of-polarization field experiments.
Jun 03 Complete risk reduction hardware experiments.
Sep 03 Complete preliminary design for prototype.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 2002	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development				R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04					
COST *(In Millions)*	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Sensors and Exploitation Systems SGT-04	73.918	106.807	121.000	105.517	90.367	90.200	90.865	Continuing	Continuing

(U) Mission Description:

(U) The Sensors and Exploitation Systems project funds the development and demonstration of advanced sensors and systems to exploit sensor products. These efforts, in conjunction with those described in Projects SGT-01, SGT-02 and SGT-03, seek to develop the systems needed to provide the warrior with situational awareness and precision target identification and attack capability, with particular emphasis on the most stressing threats. The strategic goals of this project are to: develop key sensor technologies required to support battlefield dominance, including sensors that can counter Camouflage, Concealment and Deception (CC&D); provide near-real-time, semi-automatic exploitation of wide-area moderate (and high) resolution imagery; provide real-time, accurate Battle Damage Assessment (BDA); and provide robust, precise and reliable identification, precision fire control tracking and engagement of high value units, and critical moving targets. These goals are being addressed by the following programs: Counter CC&D; Affordable Moving Surface Target Engagement (AMSTE); Organic Ground Moving Target Identification (GMTI) Radar (OGR); Eyeball Program; Real-Time Battle Damage Assessment (R/T BDA); Tactical Targeting Network Technologies (TTNT); Dynamic Tactical Targeting (DTT); and the Knowledge Aided Sensor Signal Processing and Expert Reasoning (KASSPER), a multispectral electro-optical (EO)/infrared (IR)/radar identification concept. Three new initiatives: Dynamic Tactical Sensing, Exploitation of Precision Data, and Tactical Sensor Network Technologies will be funded in FY 2003.

(U) The goal of the Counter Camouflage, Concealment and Deception (CC&D) program is to significantly enhance the military's capability to detect obscured targets hidden under foliage and camouflage. Specific goals include validation of Foliage Penetration (FOPEN) target detection and false alarm rejection capability. The FOPEN SAR is being developed for demonstration on a manned platform providing inputs via narrowband tactical data links for ground image exploitation. A Ground Control and Display Subsystem is being developed to provide real-time, remote operation of the FOPEN SAR, Automatic Target Detection and Cueing and a Common Imagery Ground/Surface System-compliant exploitation interface. The image exploitation processing of SAIP will be extended via the Multisensor Exploitation Testbed for FOPEN. Efforts are also being undertaken to evaluate the capability for FOPEN Ground Moving Target Identification and Electronic Support Measures to increase the effectiveness of future Counter CC&D systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04

(U) The goal of the Affordable Moving Surface Target Engagement (AMSTE) program is to develop and demonstrate the technologies required to perform affordable, all-weather, precision negation of moving surface targets (both land- and sea-based), from stand-off ranges using netted tactical and theater ground moving target indication (GMTI) sensors and weapons. The precise cueing from the netted GMTI sensors will allow for lower-cost weapons by reducing the complexity of precision munitions. Weapons system architectures will be developed and integrated to support a series of precision fire control bomb-drop field experiments and demonstrations. In-flight midcourse and terminal guidance to weapons will also be implemented to demonstrate weapon system accuracy that is an order of magnitude better than current systems against moving targets. A number of critical technologies must be developed including unaided precision grid locking techniques, low-cost weapon data links, low-cost weapon seekers and advanced multi-platform tracking algorithms for both precision and long-duration, high-confidence track purity using moving target feature phenomenology for track maintenance. Additionally, battle management, command, control and communications (BM/C3) experiments will be pursued jointly with Service partners to enable rapid inclusion of AMSTE-enabled engagement capabilities into future operational architectures.

(U) The objective of the Organic Ground Moving Target Identification (GMTI) Radar (OGR) program is to develop the technologies required to enable a low-cost capability for the ground-based detection and tracking of moving vehicles and personnel through foliage. The goal is to detect vehicles at ranges of 5-10 km and personnel at ranges of 1-3 km with low false alarm rates. One concept is based on the use of separate transmitters and receivers that are designed for low cost and portability. The transmitter can be either an "organic" transmit asset that is attached to an Army or Marine unit, or a non-cooperative emitter of opportunity such as a HDTV station or an airborne transmitter. False alarm reduction and target tracking will be achieved through the creation of multiple narrow azimuth receive beams using high-speed digital beam forming computers. To ensure adequate foliage penetration, the system will be designed to operate in the VHF-UHF frequency regime. A second concept is to deploy small L-Band monostatic radars at high altitude (e.g. 500-1500 m) and gain foliage penetration through steep look-down angles.

(U) The goal of the Eyeball program is to develop and demonstrate novel concepts for precision target identification (ID) of moving and stationary tactical targets from standoff platforms by electro-optical sensors working in conjunction with air- and space-based radar GMTI and SAR sensors. This program is motivated by the expectation that while future radar assets will have the capability to perform target detection, location and tracking, and even some forms of target classification, target ID performance will be insufficient to allow targeting and allocation of attack assets due to radar and signature limitations. The Eyeball sensor will exploit the benefits of combining spatial, spectral and polarimetric signatures from sparse or filled apertures to enable real-time precision ID of critical tactical targets. In the concept of operations, a GMTI-SAR platform hands-off moving and stationary target location information to the Eyeball sensor. Eyeball identifies the target at standoff ranges and returns the target ID to the radar for track file association. Through episodic revisits by Eyeball, the GMTI-SAR platform maintains continuous track of the identified

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04

tactical target. The critical aspect of this program is to understand what is required in terms of combined spatial, spectral, and polarimetric signatures and resolution trades across the sensing domains to realize the required target ID performance. To achieve this critical understanding, the Eyeball program will conduct phenomenology, modeling, architecture/system trades, and ground-based experiments to validate and demonstrate the technology.

(U) The goal of the Real-Time Battle Damage Assessment (R/T BDA) program is to develop and evaluate technology to permit all-weather, in-theater assessment of the effects of precision weapons on mobile threats. R/T BDA will exploit synthetic aperture radar sensors, including organic and theater sensors, to assess effectiveness of munitions delivery and provide feedback to attack systems during the mission, with a goal of providing weapon effectiveness feedback to the operator within 10 minutes of engagement. R/T BDA will also explore very low-cost, "pop-off" sensors deployed from incoming weapons at pre-determined times before weapon impact. R/T BDA will focus on identifying and assessing weapons effects from precision guided munitions, submunitions, sensor-fuzed weapons, and similar weapons that typically provide less energetic effects on the target and are therefore more difficult to assess by traditional BDA techniques.

(U) The Tactical Targeting Network Technologies (TTNT) program will develop, evaluate and demonstrate rapidly reconfigurable, affordable, robust, interoperable and evolvable communications technologies specifically to support networked targeting applications. There is an increasing trend across the Armed Services towards the use of tactical computer-to-computer communications networks (ex. JTIDS) for a variety of missions. Emerging networked targeting applications, designed to keep fleeting targets at risk, impose unprecedented network reconfigurability demands. Specifically, the program will develop and demonstrate a prototype distributed tactical network that will be reconfigurable in fractions of a second, have wideband capacity on demand, have near zero latency, facilitate transparent operation within existing links, and be inexpensive enough to be ubiquitous. Technologies to be developed include wideband waveform underlays, and rapid network planning tools and advanced network simulations.

(U) The Dynamic Tactical Targeting (DTT) program will develop new sensor control and fusion technologies that will leverage technology developed in the Dynamic Database (DDB) and Advanced Intelligence, Surveillance and Reconnaissance (ISR) Management (AIM) programs to enable a tactically responsive targeting process to be managed by Warfighters. The DTT program will design, build and demonstrate a system that will: a) leverage existing National/Theater intelligence, surveillance and reconnaissance (ISR) processes for timely extraction of critical data; b) register in-situ sensor data with ISR data to conduct geo-spatial and temporal registration of all sensor data by leveraging, for example, devices from the Digital Radio Frequency Tags (DraFT) program to perform as multi-spectral transponders; c) fuse in-situ sensor data with ISR data from all sources to enable multi-scale estimation of target location, identity and activity; d) dynamically task in-situ sensors to fill ISR coverage gaps and

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04

provide relevant sensor observation in areas of tactical interest; and e) process and manage the large volume of data produced by all these sensors in time to provide needed information to shooters. One of the important products at the end of the DTT program will be a testbed capable of demonstrating closed loop (data fusion and sensor management) operation to support real time targeting of mobile TCTs in a field environment.

(U) The Knowledge Aided Sensor Signal Processing and Expert Reasoning (KASSPER) program will radically alter the fundamental "front-end" signal processing architectures within the radar discipline through the real-time integration of dynamic environmental knowledge to dramatically improve clutter and interference rejection and significantly enhance sensor products. All conventional and advanced RF sensors that employ any form of adaptive signal processing estimate the background interference using the same data that is used for target detection. Additionally, it is assumed that the background interference over the region used to perform the estimation is stationary and homogeneous. This assumption is not valid – numerous sensors have demonstrated so in real environments around the world. This problem manifests itself in increased false alarms, decreased target detections, and substantially degraded minimal detectable velocities in GMTI systems. KASSPER will leverage the advent of detailed databases and high fidelity models to incorporate inhomogeneities and non-stationarity at the very front end of adaptive signal processing systems. Key technologies to be developed include advanced algorithms and high-performance computing architectures capable of performing very memory intensive adaptive signal processing. Extensive data collections will be carried out and the program will culminate in a real-time demonstration of its processing gains on military aircraft in both monostatic and bistatic modes.

(U) The new Dynamic Tactical Sensing initiative will develop sensors, signal processing, and sensor exploitation tools to close gaps in coverage achievable with current sensors. These will range from small, close-in sensors that confirm specific target characteristics, to large, standoff sensors that detect target indicators over wide areas.

(U) The objective of the new Exploitation of Precision Data initiative will be to combine data from a variety of sensors, of different types (especially radar, video, and lidar), into an extremely high confidence assessment of target type and operational status. It will develop target signatures both from models and data collected from real-time operations, match those against new data, and confirm that a particular vehicle is, or is not, a valid target.

(U) The objective of the new Tactical Sensor Network Technologies (TSNT) initiative will be to build detection, tracking, identification, and pattern analysis algorithms that operate at all nodes within a networked system. The actual processing to be performed at each network node will depend on the sensors reporting to that node, the commanders subscribing to that node, and load-balancing performed at the algorithm level. The

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04

product will be truly distributed situation awareness, resilient to the failure of any individual node, but sufficiently consistent to serve as the basis for collaborative tactical planning.

(U) Program Accomplishments and Plans:

(U) FY 2001 Accomplishments:

- Counter Camouflage, Concealment and Deception (CC&D). ($18.658 Million)
  - Completed FOPEN SAR preliminary flight test.
  - Completed first FOPEN SAR development flight test to gather data on targets and background algorithm training.
  - Continued FOPEN GMTI/ESM data analysis and signal processor development to mitigate false alarms and clutter contamination.
  - Completed SAR and spectral data fusion analysis.
  - Conducted wide-band FOPEN GMTI experiment.

- Affordable Moving Surface Target Engagement (AMSTE). ($35.376 Million)
  - Designed, developed and fabricated the initial field experiment system, including airborne sensors modified to support real-time fire control and a weapon data link.
  - Conducted field experiments to evaluate the capability to perform precision fire control targeting against moving targets, culminating in an inert weapon drop.
  - Evaluated data recorded during field experiments. Laboratory analyses included investigation of various levels of sensor performance, use of a low-cost terminal guidance seeker and extrapolation to operational systems.
  - Conducted Link –16 network planning experiments with Air Force, Navy, Army and USMC at Nellis AFB. The software generated for these experiments has been employed since the initiation of Operation Enduring Freedom to design Link 16 networks
  - Developed advanced target track maintenance techniques for integration into the precision fire control tracker and test in the laboratory on recorded data to support subsequent AMSTE field experiments.
  - Developed advanced GMTI processing approaches to mitigate track contamination.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04

- Organic Ground Moving Target Identification Radar (OGR). ($7.610 Million)
  - Completed studies for advanced transmit and receive antenna concepts.
  - Completed detailed data collections at multiple sites using both airborne and ground based transmitters to characterize propagation effects, radar phenomenology and system performance.
  - Demonstrated target detection using VHF HDTV station as transmitter.

- Eyeball. ($1.817 Million)
  - Conducted concept definition including phenomenology assessment, spatial-spectral-polarimetric trades, modeling and simulation, and experiment requirements definition.
  - Initiated the sensor testbed design and perform risk mitigation activities.
  - Linked polarimetric model enhancements into the Spectropolarimetric Sensor Evaluator, developed new model elements and validated against measured data sets.

- Real-Time Battle Damage Assessment (R/T BDA). ($10.457 Million)
  - Conducted RF data collection efforts, including both in-flight and turntable collections.
  - Identified preliminary RF techniques to exploit change detection to identify weapons-effects signatures in synchronized pre- and post-strike SAR imagery.
  - Initiated algorithm development to exploit thru-strike radar phase history data, and identified a promising approach involving cross-range energy "smearing" at the time of the strike.
  - Initiated precision munition "pop-off" BDA sensor conceptual designs for a range of weapons.

(U) FY 2002 Plans:

- Counter Camouflage, Concealment and Deception (CC&D). ($15.120 Million)
  - Complete FOPEN SAR development flight tests.
  - Conduct FOPEN SAR validation flight tests to demonstrate that the FOPEN system meets the target detection and false alarm goals.
  - Conduct user demonstrations of the FOPEN SAR in conjunction with Army and Air Force exercises.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04

- Continue developing techniques for false alarm and clutter contamination mitigation.
- Collect data to support terrain characterization under foliage.

- Affordable Moving Surface Target Engagement (AMSTE). ($40.962 Million)
  - Completed design, development and fabrication of an enhanced field experiment system to support evaluation of moving target engagement capabilities.
  - Developed and evaluated signature aided tracking approaches, sensor modes, and sensor mode management to support long-term track maintenance.
  - Conducted field experiments to evaluate the capability to provide complete kill-chain integration from standoff detection, through continuous track maintenance, to the precision fire control end game targeting of moving vehicles. Field and laboratory experimentation were focused on complex target densities, target dynamics, and enhanced bias estimation/removal approaches.
  - Demonstrated a full AMSTE weapons delivery capability in live weapons drops with complex target dynamics.
  - Integrated advanced target track maintenance techniques into the system to support field experiments.

- Organic Ground Moving Target Identification Radar (OGR). ($4.186 Million)
  - Integrate advanced receiver and antenna with OGR baseline system.
  - Demonstrate increased tunable bandwidth receive system.
  - Perform HDTV transmitter experiments using both VHF and UHF illuminators.
  - Perform L-Band radar development and testing
  - Conduct operational demonstrations of the OGR system.

- Eyeball. ($5.663 Million)
  - Complete sensor testbed design including selected aperture and spectral-polarimetric sensor configurations.
  - Conduct a critical design review (CDR).
  - Release testbed long lead times and initiate development of fabrication and test plans.
  - Complete polarimetric modeling development and integration into Spectropolarimetric Sensor Evaluator.
  - Initiate development of target detection and identification algorithms.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04

- Real-Time Battle Damage Assessment (R/T BDA). ($12.691 Million)
  - Evaluate robust candidate RF algorithmic techniques against data collected from instrumented live fire testing.
  - Develop planning and sensor management tools to support R/T BDA BM/C3.
  - Develop 3-D, geometry-based, coupled target signature/weapons effectiveness assessment models.
  - Conduct preliminary design review of weapon mounted BDA sensor.

- Tactical Targeting Network Technologies (TTNT). ($9.089 Million)
  - Complete studies, simulations and initial feasibility experiments.
  - Conduct risk reduction experiments for critical components.
  - Define infrastructure requirements

- Dynamic Tactical Targeting (DTT). ($9.096 Million)
  - Define and apply a methodology that allows design and implementation of an information collection/processing and assessment system for the DTT application.
  - Develop an information architecture that is adaptable to the individual user needs at multiple levels of command engaged in diverse missions.
  - Develop models for selected in-situ sensors.
  - Build and validate models for a dynamic, context sensitive information process.
  - Develop approaches to effectively and dynamically register all information products from in-situ, ISR and mapping sources.
  - Develop new adaptive fusion techniques (e.g. adaptation logic beyond that associated with selecting among “fusion engines”) for alignment, association, and estimation.

- Knowledge Aided Sensor Signal Processing and Expert Reasoning (KASSPER). ($10.000 Million)
  - Initiate advanced algorithm development using simulated data sets to identify knowledge source requirements.
  - Collect highly instrumented monostatic data sets.
  - Develop KASSPER Constant False Alarm Rate and Radar (CFAR) algorithms exploiting database and expert reasoning techniques.
  - Define high performance embedded computing architecture to enable rapid memory access.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04

- Initiate advanced algorithms for real-time demonstration.
- Initiate development for real-time, high-dimensionality KASSPER software.

(U) FY 2003 Plans:

- Affordable Moving Surface Target Engagement (AMSTE). ($28.090 Million)
  - Complete design, development and fabrication of the final field experiment system to support demonstration and evaluation of moving target engagement capabilities in an integrated operational environment.
  - Conduct field experiments utilizing realistic threats, environments and threat doctrine to demonstrate and evaluate the capability to provide a complete, integrated end-to-end technical capability for targeting and engaging moving vehicles. Demonstration focus will include integration of operational sensors and live weapons with operational battle management/command and control.

- Eyeball. ($4.683 Million)
  - Complete sensor testbed fabrication, integration and testing.
  - Complete sensor testbed data collection and demonstration plans.
  - Complete development of target detection and identification algorithms.
  - Conduct sensor testbed data collects and perform data analysis defining end-to-end sensor validation and sensor requirements.
  - Validate spectral-polarimetric target detection and identification algorithm performance.
  - Demonstrate real-time target identification concept.

- Real-Time Battle Damage Assessment (R/T BDA). ($11.800 Million)
  - Perform integrated R/T SAR BDA experiments/demonstrations utilizing real time tasking, sensor exploitation and effects assessment in live fire environment.
  - Complete CDR and initiate fabrication of weapon mounted BDA sensor.

- Tactical Targeting Network Technologies (TTNT). ($18.927 Million)
  - Complete simulation basis for Hardware-in-the-Loop (HWIL) testing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04

- Complete system and sub-system risk reduction experiments.
- Complete brassboard design.

- Dynamic Tactical Targeting (DTT). ($12.500 Million)
  - Complete selection of appropriate in-situ sensors to fuse with national and theater intelligence, surveillance and reconnaissance (ISR) sensors. Leverage Dynamic Database (DDB) technology to develop algorithms to fuse data from in-situ and ISR sensors. Conduct preliminary data collection and/or simulation to enable fusion development.
  - Define metrics for characterizing behavior of information models developed.
  - Develop and use models and techniques for registering data products across multiple sensors to a common geo-spatial and temporal reference.
  - Leverage DDB and Advanced Intelligence, Surveillance and Reconnaissance (ISR) Management (AIM) closed loop experimentation to develop a multi-sensor collection strategy to enable targeting of mobile time critical targets (TCTs).
  - Complete preliminary design of a transportable DTT testbed that will interface with Service operational systems to enable experiments in field exercises.

- Dynamic Tactical Sensing. ($10.000 Million)
  - Develop sensors and exploitation tools to fill in gaps in DTT sensor coverage, with an emphasis on unambiguous target identification.
  - Conduct analyses and experiments to assess the value of providing stand-off sensor support to tactical ground forces.
  - Conduct analyses and experiments to demonstrate the value of wide-area sensing to rapid, decisive, long-range strike operations.

- Knowledge Aided Sensor Signal Processing and Expert Reasoning (KASSPER). ($15.000 Million)
  - Conduct off-line KASSPER Constant False Alarm Rate & Radar (CFAR) demonstration.
  - Continue advanced algorithm development and performance estimation using simulated and real data sets.
  - Collect highly instrumented monostatic data sets onboard Advanced Airborne Sensor Platform (AASP).
  - Conduct CDR of real-time demonstration of KASSPER CFAR algorithms within the Joint STARS T-3 sensor architecture.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04

- Conduct PDR of real-time KASSPER beamforming for AASP platform.
- Initiate real-time test planning and demonstration for AASP.

- Exploitation of Precision Data. ($10.000 Million)
  - Develop tools to classify, identify, and characterize the operational state of ground targets using data from 3D sensors (e.g., LADAR) and structural models of target geometry
  - Extend model-based vision technologies to classify, identify, and characterize the operational state of ground targets from video data.

- Tactical Sensor Network Technologies (TSNT). ($10.000 Million)
  - Develop algorithms for distributed situation assessment at all nodes of a networked group of sensors.
  - Incorporate tracking, target identification, and target assignment algorithms for fully distributed operation.

(U) Other Program Funding Summary Cost:

- Not Applicable.

(U) Schedule Profile:

Plan	Milestones
Foliage Penetration (FOPEN):	
Apr 02	FOPEN SAR testing in southern pine forest.
Jul 02	FOPEN SAR testing of SAM site, surrogate drug lab and terrain characterization.
Sep 02	FOPEN SAR testing in northern flat-floor forest.
Oct 02	Verify FOPEN SAR automatic target detection and cueing (Blind Test).
Affordable Moving Surface Target Engagement (AMSTE):	
Sep 02	AMSTE live weapons demonstration and track maintenance integrated field experiment.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04

Aug 03	AMSTE end-to-end system operational demonstration with BM/C3 integration and full threat dynamics.

Organic Ground Moving Target Identification (OGMTI):

Feb 02	Test OGR using VHF and UHF HDTV station as transmitter.
Jun 02	Test L-Band OGR concept
Aug 02	Demonstrate OGR operational utility.

Eyeball:

Jun 02	Complete Eyeball sensor testbed design and fully integrate spectral-polarimetric model into Spectropolarimetric Sensor Evaluator.
Jun 03	Complete Eyeball target detection and identification algorithm development.
Sep 03	Validate Eyeball sensor experiment data collection and system.

Real-Time Battle Damage Assessment (R/T BDA):

Feb 02	Validate R/T BDA coupled target signature/weapons effects models.
May 02	Complete preliminary design of RT/BDA weapon-deployed sensor.
Sep 02	Complete integrated SAR R/T BDA experiment/demonstration design.
Jan 03	Complete CDR of R/T BDA weapon-deployed sensor.
Jul 03	Conduct SAR R/T BDA integrated demonstration.

Tactical Targeting Network Technologies (TTNT):

Jul 02	Complete TTNT common tasks and complete distribution of results to primes.
Aug 02	Complete in-depth studies, simulations and feasibility experiments.
Sep 02	Down select the prime contractors to enter phase two of TTNT.
May 03	Complete all TTNT simulation studies up to and including HWIL.
Aug 03	Complete HWIL testing of candidate TTNT brassboard designs.
Sep 03	Down select the prime contractor(s) to enter phase three of TTNT.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2002
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, Project SGT-04

Dynamic Tactical Targeting (DTT):

May 02	DTT component design completed and evaluated.
Jul 02	DTT technical approach defined and coordinated.
Apr 03	DTT laboratory experiments – validation/selection of components.
Jun 03	DTT components available to system integrator.

Knowledge Aided Sensor Signal Processing and Expert Reasoning (KASSPER):

Apr 02	Radar data collection.
Aug 02	Real-time algorithm Preliminary Design Review.
Mar 03	Multi-channel radar data collection (AASP).
Jul 03	Algorithm Critical Design Review – real-time demo freeze.
Aug 03	High performance embedded computing architecture Preliminary Design Review.
Aug 03	Off-Line demonstration of order of magnitude reduction in false alarm rate for monostatic application.

Dynamic Tactical Sensing (DTS)

May 03	Complete initial experiment plan
Sep 03	Complete initial experiment

Exploitation of Precision Data

Dec 03	Obtain initial set of target models and simulated observational data
Aug 03	Characterize performance of baseline algorithms

Tactical Sensor Network Technologies

Dec 02	Develop initial sensor architecture and concept of employment
Jun 03	Baseline functional components and data flows for tactical scenarios
Sep 03	Test baseline algorithms in single nodes