RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Sensor and Guidance Technology PE 0603762E, R-1 #48

COST *(In Millions)*	FY 2000	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007	Cost To Complete	Total Cost
Total Program Element (PE) Cost	176.843	139.858	203.095	178.715	217.400	226.600	234.900	239.900	Continuing	Continuing
Guidance Technology SGT-01	18.069	20.844	30.605	21.964	26.515	29.568	29.568	29.568	Continuing	Continuing
Aerospace Surveillance Technology SGT-02	41.425	22.466	22.338	43.232	70.550	80.000	89.300	89.300	Continuing	Continuing
Air Defense Initiative SGT-03	35.884	21.941	32.667	10.000	12.750	14.200	23.200	28.200	Continuing	Continuing
Sensors and Exploitation Systems SGT-04	81.465	74.607	117.485	103.519	107.585	102.832	92.832	92.832	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, high performance computing and low cost micro-electronics technologies.

(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.

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(U) The objective of the Sensors and Exploitation Systems project is to provide the warrior with situational awareness and battlefield dominance by developing key sensor technologies; provide near-real-time semi-automatic exploitation of wide-area moderate resolution imagery data; provide real-time and accurate battlefield assessment and semi-automated precise and reliable target recognition and targeting of critical moving targets.

(U) **Program Change Summary:** (*In Millions*)	**FY2000**	**FY 2001**	**FY 2002**
Previous President's Budget	177.598	182.225	203.424
Current Budget	176.843	139.858	203.095

(U) Change Summary Explanation:

FY 2000	Decrease reflects minor program repricing and SBIR reprogramming.
FY 2001	Decrease reflects net effect of congressional program reductions, congressional add for Large Millimeter Telescope, Section 8086 reduction and government-wide rescission.
FY 2002	Decrease reflects net effect of Discover II program termination, offset by planned expansions in the FOPEN Radar, and the Low Cost Cruise Missile Defense program, and initiation of an Extremely Large Space Antenna Study.

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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 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Guidance Technology SGT-01	18.069	20.844	30.605	21.964	26.515	29.568	29.568	29.568	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. The Global Positioning System (GPS) Guidance Package (GGP) technologies funded in this project are applicable for both new or retrofit guidance/navigation packages for a variety of airborne platforms, ground vehicles, surface-to-surface standoff weapons and air-to-surface weapons. Additional thrusts are also included in this project to increase the ability of 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 (Advanced Tactical Targeting Technology Program).

(U) GGP tightly integrates a miniature GPS receiver and an all-solid state, low cost, navigation-grade, interferometric fiber optic gyroscope (IFOG) based miniature inertial measurement unit (MIMU) with an advanced navigation computer into a low cost ($15,000), precision navigation system. GGP Phase I addressed the technology issues involved in: (1) miniaturizing navigation grade inertial measurement units (IMUs) into a compact, manufacturable configuration; and (2) developing a multi-channel-on-chip, high dynamics GPS receiver. A Memorandum of Agreement (MOA) has been signed and implemented to demonstrate a Phase 1 unit on an Army Fire Support Team Vehicle (FIST-V). Successful demonstrations were conducted at Redstone Arsenal in June 1995 using a M981 FIST-V. Successful demonstrations also were conducted on an F/A-18. These tests assessed the performance of tightly coupled systems in high dynamics and validated Phase 1 design scenarios. GGP Phase 2 requirements place more stressing demands on performance of MIMU components and call for further reductions in size, power and weight.

(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

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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 will meet three key challenges. First, it will demonstrate non-Keplerian orbit predictions of the APL and show 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.

(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 and perform INS simulations of the modeled sensors. 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.

(U) The Advanced Tactical Targeting Technology (AT3) program will demonstrate a passive tactical targeting system for the lethal suppression of enemy air defenses (SEAD). The targeting system must negate emitter shutdown tactics now employed to defeat 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 radios with advanced network management and signal processing. Additionally, to achieve the necessary wide deployment, AT3 self-contained collection packages must impose negligible burden on their airborne hosts and be available at affordable prices. 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

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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 US 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 phenomonological measurements and develop countermeasures and target classification/identification techniques; (2) develop critical 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 2000 Accomplishments:

- GPS Guidance Package (GGP) Global Positioning Experiments (GPX). ($ 3.621 Million)
  - Completed integration of GGP and field demonstrations.
  - Demonstrated ability of airborne pseudolites to provide high quality navigation data to GPS users during jamming.
  - Conducted laboratory demonstration of adaptive signal processing and digital beamformer for pseudolite anti-jam capability.

- Microelectromechanical Sensor Inertial Navigation System (MEMS INS). ($ 7.042 Million)
  - Began MEMS INS integration with navigation software to demonstrate IMU operation.

- Advanced Tactical Targeting Technology. ($ 7.406 Million)
  - Completed Advanced Tactical Targeting critical design and began fabrication.

(U) FY 2001 Plans:

- Global Positioning Experiments (GPX). ($ 3.796 Million)

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- Complete development and evaluation of elements of the pseudolite network.
- Initiate integrated demonstration using a single airborne pseudolite with integrated digital adaptive beamforming antenna.

- Microelectromechanical Sensor Inertial Navigation System (MEMS INS). ($ 5.402 Million)
  - Deliver MEMS inertial measurement unit to the Government.

- Advanced Tactical Targeting Technology. ($ 11.646 Million)
  - Complete fabrication and ground tests.
  - Initiate advanced algorithm development.
  - Complete study of EO/IR SAM fire control targeting.

(U) FY 2002 Plans:

- Global Positioning Experiments (GPX). ($ 8.043 Million)
  - Complete captive carry weapon demonstration in a GPS jamming environment.
  - Initiate fabrication of multiple airborne pseudolites.

- Microelectromechanical Sensor Inertial Navigation System (MEMS INS). ($ 1.880 Million)
  - Complete field demonstration of MEMS INS navigation capabilities.

- Advanced Tactical Targeting Technology. ($ 9.725 Million)
  - Conduct experimental flight tests and real-time multi-ship demonstrations.

- MEDUSA. ($ 10.957 Million)
  - Develop and evaluate MEDUSA countermeasure and classification techniques and conduct phenomonological measurements.
  - Initiate critical component technology development.

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(U) Other Program Funding Summary Cost:

- Not Applicable.

(U) Schedule Profile:

Plan	Milestones
Jun 01	Complete GPX evaluation of pseudolite elements.
Jul 01	Deliver GGP units to the Government (second source).
Nov 01	Complete AT3 ground tests.
Feb 02	Complete laboratory demonstration of MEMS INS operations.
Jun 02	Complete field test/demonstration of MEMS IMU.
Jul 02	Demonstrate GPX airborne pseudolite operation with captive carry weapons.
Sep 02	Complete AT3 real-time flight tests.
Jun 03	Demonstrate in GPX integrated pseudolite system with live fire weapons in jamming environments.
Aug 03	Complete AT3 data analysis and field demonstrations.
Sep 03	Complete MEDUSA measurements database and breadboard system.

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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 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Aerospace Surveillance Technology SGT-02	41.425	22.466	22.338	43.232	70.550	80.000	89.300	89.300	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 architecture can be exploited for other missions, with the net effect of substantially enhancing U.S. situational awareness and combat identification advantages.

(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 program (CUGF) 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. The program has been expanded to include development and demonstration of a tactical missile that would have the ability to attack UGFs, the TACM-P system.

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(U) 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 high-availability, all-weather, survivable and short response time means to destroy hard and deeply-buried targets. The TACM-P ACTD has been endorsed by three Commanders in Chief (CINCs) to solve urgent needs within their theaters. U.S. Pacific Command is the operational sponsor.

(U) The RotoSAR program will develop revolutionary sensing capability by installing a receive antenna into the rotor blades of a surveillance or attack helicopter, either manned (e.g. Comanche, Apache), or unmanned (DARPA's hummingbird). The dynamics of helicopter blades enables a larger synthetic aperture, allowing improved ground moving target detection, particularly at low frequencies, such as required for foliage penetration. Under this program, techniques will be developed to compensate for blade motion in SAR/GMTI post-processing, transmit high bandwidth signals from a conformal antenna on the fuselage, and integrate the electronic receive antenna components with the (conductive) structural blade materials in a low loss and affordable manner. RotoSAR will be demonstrated on a tower mounted surrogate platform prior to insertion on a rotocraft. The presence of RotoSAR on an unmanned surveillance rotorcraft will provide a radar capability for immediate support of the battlefield commander.

(U) The Space Surveillance program will develop and demonstrate an advanced imaging 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 purpose such as asteroid detection and other defense missions.

(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.

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(U) Program Accomplishments and Plans:

(U) FY 2000 Accomplishments:

- Digital Radio Frequency (RF) Tags. ($ 8.351 Million)
  - Completed a Preliminary Design Review (PDR) for a digital RF Tag, system level trade study, and technology insertion plan; selected two approaches for continued development.
  - Initiated advanced development of data encoding and extraction algorithms.

- Adaptive Spectral Reconnaissance. ($ 3.978 Million)
  - Completed visible through near infrared (VNIR)/short wave infrared (SWIR) algorithm development, including implementation of new algorithms and hybrid fusion techniques.
  - Completed VNIR/SWIR data collection, analysis and validation activities, including collections at Fort A.P. Hill and Aberdeen Proving Grounds.
  - Completed validation of end-to-end VNIR/SWIR spectral model including real/synthetic imagery generation, atmospheric/path radiance components, sensor models, platform dynamics and algorithm segments.
  - Completed spectral target and background signature database; released for distribution.

- Discoverer II. ($ 13.635 Million)
  - Completed Phase I satellite design efforts with two system integration (SI) contractor teams. Successfully completed second Interim Evaluation Review (IER) and IER-3 culminating in preliminary designs for demonstration satellites.
  - Completed mission utility analyses and concept of operations studies.
  - Built and tested sub-scale radar antenna designs, advanced signal processors and exploitation software.
  - Flew radar payload simulator on airborne asset; collected and analyzed data.

- Novel Antennas. ($ 1.497 Million)
  - Initiated analysis of next generation geolocation techniques technology for ground based communications exploitation.

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- Counter-Underground Facilities. ($ 10.464 Million)
  - Initiated robust modeling of passive acoustic-seismic-electromagnetic (PASEM) effluent signatures and backgrounds.
  - Initiated planning for field measurements to verify phenomenology, validate models and explore sensor deployment concepts.
  - Developed engineering descriptions of operational sites and their surrounding environments to support model validation and evaluation of system concepts within operational context.
  - Initiated active seismic characterization and battle damage assessment models and field experiments.
  - Initiated electromagnetic sensor technology development activities.

- Underground Facilities Detection. ($ 1.500 Million)
  - Initiated and evaluated acoustic and seismic technologies to improve underground facilities detection capabilities.

- Large Millimeter Telescope. ($ 2.000 Million)
  - Completed critical system design review.
  - Completed First Article Antenna Surface Panel.
  - Completed 3 mm receiver and conducted Bolometer test using CalTech telescope.

(U) FY 2001 Plans:

- Digital Radio Frequency (RF) Tags. ($ 6.575 Million)
  - Complete critical design review (CDR) for digital RF tag.
  - Conduct component risk reduction tests on brassboard system.

- Counter-Underground Facilities. ($ 11.891 Million)
  - Complete passive acoustic, seismic, electromagnetic (PASEM), and effluents modeling of signatures and backgrounds.
  - Initiate model validation experiments.
  - Initiate design for prototype PASEM demonstration system.
  - Develop and evaluate interface requirements definition and initiate hardware/software design for the Tactical Missile – Penetrator (TACM-P).

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- Large Millimeter Telescope. ($ 4.000 Million)
  - Complete detector/pointing system baseline controls.

(U) FY 2002 Plans:

- Digital Radio Frequency (RF) Tags. ($ 4.946 Million)
  - Complete tag prototype units.
  - Conduct laboratory device testing and characterization.

- Counter-Underground Facilities. ($ 8.446 Million)
  - Complete model validation for seismic, acoustic, electromagnetic and effluent signatures and backgrounds.
  - Complete passive acoustic, seismic, electromagnetic (PASEM), demonstration system design and fabrication.
  - Complete hardware/software design and initiate missile re-entry body system tests of the Tactical Missile – Penetrator (TACM-P).
  - Continue to develop and evaluate interface requirements definition and initiate hardware/software design for the Tactical Missile – Penetrator (TACM-P)

- RotoSAR. ($ 5.000 Million)
  - Perform analysis of post-processing requirements for blade motion compensation.
  - Identify candidate platform for installation and initiate system concept development.
  - Begin antenna module development.
  - Perform electromagnetic modeling of antenna/airframe interaction.
  - Develop software for synthetic aperture radar/ground moving target indicator (SAR/GMTI) from moving blades.
  - Conduct tower based demonstration of rotating blade concept from a signal processing perspective (non-real time).
  - Demonstrate, and quantify performance of, ultra high frequency (UHF) moving target indicator (MTI) from slow platforms using truck mounted UHF arrays.
  - Build and test a field deployable K-band rotosar surrogate, and demonstrate clutter mitigation techniques.

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- Space Surveillance ($ 3.946 Million)
  - Complete telescope design.
  - Complete focal plane design.

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

Adaptive Spectral Reconnaissance:

Source	FY 2000	FY 2001	FY 2002
Army	4.000	1.900	0.000

Discoverer II:

Source	FY 2000	FY 2001	FY 2002
NRO	13.330	0.000	0.000

Tactical Missile – Penetrator (TACM-P):

Source	FY 2000	FY 2001	FY 2002
OSD/ASCE PE 0603750D8Z	0.000	4.300	6.600
Air Force	13.170	0.000	0.000

(U) Schedule Profile:

Plan	Milestones
Digital Radio Frequency (RF) Tags:	
Oct 01	Final design review complete (FDR) for digital RF tag prototype.
June 02	Prototype RF tag component hardware fabrication and testing complete.
Counter-Underground Facilities:	
Sep 01	Complete interface requirements; conduct CDR for re-entry body; initiate hardware/software design for re-entry body.

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Nov 01 Complete model validation experiments.
Sep 02 Complete passive acoustic, seismic, electromagnetic (PASEM) demonstration system design and fabrication.
Sep 02 Complete hardware/software design for re-entry body. Conduct CDR and initiate flight hardware fabrication.

RotoSAR Program:
Apr 02 Complete post-processing requirements analysis.
May 02 Avionics preliminary design review.
Sep 02 Conduct tower based demonstrations.

Radar Technology:
Apr 02 Preliminary design review.
Aug 02 Fabricate pathfinder subscale radar.
Sep 02 Complete full-scale receiver exciter unit.
Oct 02 Subscale electronically scanned antenna (ESA) test.
Nov 02 Critical design review for full scale ESA.

Space Surveillance:
Mar 02 Focal plane design complete (preliminary design review).
Jul 02 Telescope design complete (critical design review).

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COST *(In Millions)*	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Air Defense Initiative SGT-03	35.884	21.941	32.667	10.000	12.750	14.200	23.200	28.200	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 Synthetic Aperture Radar Electronic Counter-Countermeasures (SAR ECCM), Low-Cost Cruise Missile Defense (LCCMD), Global Eye, Microelectromechanical (MEM) antenna (MEM-tenna), Extremely Large Space Antenna Study and Polarized Infrared Imaging Seeker (PIRIS) programs.

(U) The SAR ECCM program will develop techniques to make U.S. Synthetic Aperture Radar (SAR) systems less vulnerable to intentional enemy jamming or deception. SAR systems have become one of the most widely used broad area surveillance systems. They are critically important to the development of battle space awareness and their jamming and/or deception could seriously degrade U.S. warfighting capability. The SAR ECCM program will determine the military impact of various SAR jamming techniques and develop easily implemented countermeasures.

(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.

(U) The Global Eye program is developing the critical phased array antenna technologies and radar mode control concepts required for the introduction of multi-aperture, multi-function radar systems in UAVs. A UAV outfitted with this capability could provide lower cost (factor of ~20), continuous air and ground surveillance of low intensity areas such as no-fly zones and peacekeeping areas. Such capability could supplement traditional AWACS and E-2C and reduce the requirement to forward base large numbers of manned aircraft for these purposes. The key technologies to be used are: MEMS filters for simultaneous transmit and receive; polarization diversity, high efficiency solid-state transmitters;

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composite lightweight integrated antennas and advanced mode control/interleaving algorithms. Concepts will be explored which use common components to perform both the AEW mission (at the reduced ranges appropriate to this concept) and air-to-ground modes.

(U) The MEM-tenna program is developing ultra-low cost, lightweight phased array antenna technologies based on MEMS phase shifters and RF beam control through optical projection techniques. MEMS technology can produce phase shifters for phased array antennas that are a small fraction of the power consumption of conventional PIN-diode or GaAs field effect transistor (FET) phase shifters, while also having low insertion losses. Hard-wired beam steering control and RF manifolds are replaced by optical and RF space-fed configurations. Using these technologies, very large-scale electronically scanned arrays (ESAs) can be developed for multiple applications. Optically controlled phase shifter designs incorporating MEMS technology are being developed and these will be incorporated into a prototype ESA having 10,000 antenna elements, operating at X-band with potential application to airborne and surface-based missions.

(U) MEM-tenna and other ultra-low cost, lightweight technologies offer the potential for developing and deploying extremely large antennas in space. Antennas of 100 – 300 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 study will be conducted to assess and produce feasible and affordable candidate extremely large antenna designs capable of performing tactical sensing from space.

(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 2000 Accomplishments:

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- SAR ECCM. ($ 8.064 Million)
  - Demonstrated a series of off-line image-based post-processing ECCM techniques.
  - Formally transitioned SAR ECCM algorithms to the Air Force Research Labs' Sensor Directorate for integration into the Joint STARS T-3 test platform and the Army's Common Ground Station.
  - Established problem awareness at key institutions (NGIC, NAIC and AC2ISRC) responsible for determining the Mission Need Statements (MNS) and Operational Requirements Documentation (ORD).
  - Introduced annual ECCM operational exercises into the Joint Expeditionary Force Exercise (JEFX).

- LCCMD. ($ 16.745 Million)
  - Upgraded Laser Radar (LADAR) seeker to eye-safe frequency and redesigned seeker to increase acquisition range.
  - Initiated laboratory characterization testing of upgraded LADAR seeker.
  - Initiated Micro Electro-Mechanical (MEMS) Electronically Scanned Array (ESA) radar seeker antenna subarray laboratory testing.
  - Initiated MEMS improvement program to address MEMS reliability problems identified in subarray testing.
  - Completed noise radar seeker flight system integration and initiated laboratory testing.
  - Designed noise radar seeker processor chips.

- Global Eye. ($ 3.131 Million)
  - Initiated prototype antenna and system concept designs.
  - Initiated mode control/interleaving algorithm development.
  - Initiated the design of MEMS-based filters required for the use of simultaneous transmit and receive (STAR) waveforms.

- MEM-tenna. ($ 7.944 Million)
  - Initiated design of a prototype ESA that will incorporate optically controlled X-band MEMS phase shifters, along with the design of the integrated phase shifter and optical controller modules.
  - Developed designs of MEMS X-band phase shifters and initiated prototype manufacturing to demonstrate the ability to achieve the cost and reliability goals.

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(U) FY 2001 Plans:

- LCCMD. ($ 12.473 Million)
  - Complete laboratory characterization testing of eye-safe LADAR seeker.
  - Design, fabricate and test improved RF MEMS capacitive and contact switches for use in MEMS antenna array.
  - Complete noise radar seeker China Lake field-testing.
  - Complete fabrication and testing of noise radar seeker correlator and Fast Fourier Transform (FFT) Integrated Circuit (IC) chips.

- Global Eye. ($ 3.275 Million)
  - Initiate the fabrication of MEMS-based filters to permit the use of simultaneous transmits and receive (STAR) waveforms.
  - Begin risk reduction phased array fabrication and tests.

- MEM-tenna. ($ 5.193 Million)
  - Evaluate of 100 phase shifters built by three contractors.
  - Begin manufacture of the 11,000 MEMS X-band phase shifters with optical controllers.
  - Develops array calibration techniques with both specific and general applicability.
  - Initiate MEMS lifetime and reliability program.

- Advanced Sensing Alternatives. ($ 1.000 Million)
  - Explore 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. ($ 15.000 Million)
  - Conduct real-time noise radar seeker processor demonstration using China Lake field test data.
  - Complete noise radar seeker final report.

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- 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 Engineering and Manufacturing Development (EMD) quality RF MEMS switches.

- Global Eye. ($ 2.000 Million)
  - Demonstrate continuous wave operation of sub-array.
  - Insert the MEMS filters into the prototype array and evaluate its ability to support multiple-mode operation.
  - Populate an active ESA with a sufficient number of modules and filters to demonstrate multi-mode radar compatibility with full STAR waveform transmit capability.

- MEM-tenna. ($ 3.667 Million)
  - Complete the fabrication of the 10,000 element space-fed array and perform proof-of-concept testing.
  - Evaluate remote array calibration techniques using sub-scale array.
  - Conduct experiments of alternative, novel and space-fed technologies.

- Extremely Large Space Antenna Study. ($ 11.000 Million)
  - Develop detailed conceptual designs of multiple antenna candidates.
  - Assess feasibility and affordability of designs.
  - Identify critical technologies and risk reduction requirements.

- PIRIS. ($ 1.000 Million)
  - Conduct field experiments to verify degree-of-polarization separation of targets and infrared countermeasures.
  - Conduct conceptual design of prototype-polarized seeker.

(U) Other Program Funding Summary Cost:

- Not Applicable.

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(U) Schedule Profile:

Plan	Milestones
LCCMD:	
Jun 01	Start noise radar seeker field test.
Oct 01	Start noise radar seeker real-time processor test.
Oct 02	Conduct MEMS ESA seeker critical design review.
Global Eye:	
Aug 01	Complete basic sub-array fabrication and begin testing.
Nov 01	MEMS filter insertion.
Mar 02	Begin population of active ESA for proof-of-concept demonstration.
Jun 02	Multiple-mode demonstration.
MEM-tenna:	
Jun 01	Complete MEMS lifetime and reliability study.
Aug 01	Begin production of 11,000 integrated MEMS phase shifter and optical controller modules.
Dec 01	Begin fabrication of sub-scale array.
Jun 02	Begin sub-scale array testing.
Aug 02	Conduct remote array calibration testing.
PIRIS:	
May 02	Complete degree-of-polarization field experiments.
Aug 02	Complete preliminary design for prototype.

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COST *(In Millions)*	FY 2000	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	81.465	74.607	117.485	103.519	107.585	102.832	92.832	92.832	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; Eyeball, a multispectral electro-optical (EO)/infrared (IR)/radar identification concept; Affordable Moving Surface Target Engagement (AMSTE); Real-Time Battle Damage Assessment (R/T BDA), Tactical Targeting Network Technologies (TTNT); Organic Ground Moving Target Identification (GMTI) Radar (OGR); Dynamic Tactical Targeting (DTT); Knowledge Aided Sensor Signal Processing and Expert Reasoning (KASSPER) and the Eyeball Program.

(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 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.

(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

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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 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 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 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 threat targets such as surface-to-air missile launchers, theater surface-to-surface missile launchers and multiple rocket launchers. R/T BDA will exploit organic and theater synthetic aperture radar sensors to assess effectiveness of munitions delivery and provide feedback to attack systems in mission, with a goal of providing weapon effectiveness metric 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,

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sensor-fuzed weapons, and similar weapons that typically provide less energetic effect on the target and are therefore more difficult to assess by traditional BDA techniques.

(U) 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. The Tactical Targeting Network Technologies (TTNT) program will develop, evaluate and demonstrate rapidly reconfigurable, affordable, robust, interoperable and evolvable communications technologies specifically to support this critical application class. Specifically, the program will develop and demonstrate a prototype distributed tactical network with the following features: reconfiguration in fractions of a second, wideband capacity on demand, near zero latency, transparent operation within existing links, and inexpensive enough to be ubiquitous. Technologies to be developed include wideband waveform underlays, and rapid network planning tools and advanced network simulations.

(U) The goal 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 3-5 km and personnel at ranges of 1-3 km with low false alarm rates. The concept is based on the use of separate transmitters and receivers, each of which is 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. 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.

(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 in ISR products by leveraging devices from the Digital Radio Frequency Tags (DraFT) program to develop multi-spectral transponders to conduct in-scene registration of all sensor data; 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 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

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information to shooters. The product of the DTT program will be a transportable testbed capable of demonstrating real time targeting of mobile TCTs in an operational 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) Program Accomplishments and Plans:

(U) FY 2000 Accomplishments:

- Semi-Automated Imagery Intelligence Processing (SAIP) ACTD. ($ 5.385 Million)
  - Completed operational support to the Army and Air Force SAIP residual operational capability.

- Moving and Stationary Target Acquisition and Recognition (MSTAR). ($ 15.421 Million)
  - Demonstrated major improvements in ATR performance as a function of resolution.
  - Investigated recognition capabilities using RF returns without forming the imagery.
  - Established an integration and transition capability in the Real Time ATR Laboratory (R/T ATR Lab) for the purpose of developing MSTAR based "modules" that can be used to upgrade operational ATR systems such as SAIP.

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- Demonstrated the ability to operate the MSTAR system in near real time through the use of parallel super-computers in the R/T ATR Lab. Developed a toolkit of interactive exploitation tools, integrated with commercial technology, that provided operationally useful ATR capabilities to image analysts.
- Conducted an initial exploration of MSTAR model-based reasoning technology using SAR data in conjunction with 3-D Laser Radar (LADAR) data of ground targets.

- Airborne Video Surveillance (AVS). ($ 13.016 Million)
  - Integrated, demonstrated and evaluated the following technologies in the laboratory and in some limited field experiments: Activity Monitoring – monitored activities (e.g., soldier incursion into security zones, tactical and strategic vehicle movement) and developed activity-based indexes for tactical video data stores. Precision Video Registration – Demonstrated 2 to 10-meter absolute geolocation accuracy in 80 percent of mission imagery from multiple terrain types.

- Counter Camouflage, Concealment and Deception (CC&D). ($ 27.095 Million)
  - Completed hardware development and system integration.
  - Began conducting preliminary flight tests of the FOPEN SAR Manned Airborne Demonstrator on Army aircraft.
  - Focused the Multi-Sensor Exploitation Testbed (MSET) on the development of SAR and spectral MSI image feature fusion techniques to demonstrate the achievable performance gain in overall detection and false alarm rate with multimode systems. These capabilities can be utilized with the ATD/C algorithms to demonstrate and project Counter CC&D capabilities.
  - Performed a multispectral data collection using SAR and spectral sensors to assess fusion performance for targets in shallow hide.
  - Initiated concept development studies for FOPEN GMTI/ESM.
  - Conducted a moving target signature measurement experiment.
  - Performed a data collection experiment with an airborne UHF GMTI sensor.

- Affordable Moving Surface Target Engagement (AMSTE). ($ 15.163 Million)
  - Completed a weapon system trade study of “higher-order” error terms and initial precision fire control tracking experiments. The study products included an end-to-end operational system design, end-to-end concept of operations and system performance analysis.
  - Developed multi-sensor registration, association and tracking algorithms.

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- Conducted iterative experimentation using simulated and real multi-sensor GMTI data, confirming the theoretical predictions of less than 10 m targeting errors.

- Organic Ground Moving Target Identification Radar (OGR). ($ 5.385 Million)
  - Completed the fabrication and initiated the evaluation of the brassboard proof-of-concept system.
  - Conducted testing using both airborne and ground illuminators.
  - Began planning for an experiment using an HDTV transmitter.
  - Began planning for full scale testing and evaluation.
  - Investigated the performance limitations when using non-rigid antenna structures for the receiver array. Modified to allow operation with an airborne illuminator.

(U) FY 2001 Plans:

- Counter Camouflage, Concealment and Deception (CC&D). ($ 18.831 Million)
  - Complete FOPEN SAR preliminary flight test.
  - Begin FOPEN SAR development flight test to gather data on targets and background algorithm training.
  - Continue FOPEN GMTI/ESM data analysis and signal processor development to mitigate false alarms and clutter contamination.
  - Complete SAR and spectral data fusion analysis.

- Affordable Moving Surface Target Engagement (AMSTE). ($ 35.665 Million)
  - Design, develop and fabricate the initial field experiment system, including airborne sensors modified to support real-time fire control and a weapon data link.
  - Conduct field experiments to evaluate the capability to perform precision fire control targeting against moving targets, culminating in an inert weapon drop.
  - Evaluate data recorded during field experiments. Laboratory analyses will include investigation of various levels of sensor performance, use of a low-cost terminal guidance seeker and extrapolation to operational systems.

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- Explore advanced tactical data link technologies to enable rapidly reconfigurable, low latency, wideband modes to transparently operate on existing links. Conduct Link-16 network planning experiment with the Air Force at Nellis AFB.
- Develop 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.
- Develop advanced GMTI processing approaches to mitigate track contamination.

- Organic Ground Moving Target Identification Radar (OGR). ($ 7.679 Million)
  - Enhance capabilities of brass board system.
  - Conduct detailed experiments at multiple sites using bistatic modes with both airborne and ground based transmitters to characterize propagation effects, radar phenomenology and system accuracy.
  - Begin operational demonstrations.

- Eyeball. ($ 1.872 Million)
  - Conduct concept definition including phenomenology assessment, spatial-spectral-polarimetric trades, modeling and simulation, and experiment requirements definition.
  - Initiate the sensor testbed design and perform risk mitigation activities.
  - Link polarimetric model enhancements into the Spectropolarimetric Sensor Evaluator, develop new model elements and validate against measured data sets.

- Real-Time Battle Damage Assessment (R/T BDA). ($ 10.560 Million)
  - Initiate RF data collection efforts.
  - Investigate RF techniques to exploit change detection to identify weapons-effects signatures in synchronized pre- and post-strike SAR imagery; couple this signature assessment with real-time prediction of target functional degradation.
  - Initiate algorithm development to exploit thru-strike radar phase history data.
  - Conduct precision munition “pop-off” BDA sensor conceptual designs for a range of weapons.

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(U) FY 2002 Plans:

- Counter Camouflage, Concealment and Deception (CC&D). ($ 18.000 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.
  - Continue developing techniques for false alarm and clutter contamination mitigation.
  - Conduct millimeter wave FOPEN data collects and develop conceptual design.

- Affordable Moving Surface Target Engagement (AMSTE). ($ 39.563 Million)
  - Complete design, development and fabrication of an enhanced field experiment system to support evaluation of moving target engagement capabilities.
  - Conduct 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 will be focused on complex target densities, target dynamics, and enhanced bias estimation/removal approaches.
  - Demonstrate a full AMSTE weapons delivery capability in live weapons drops.
  - Integrate advanced target track maintenance techniques into the system to support field experiments.

- Organic Ground Moving Target Identification Radar (OGR). ($ 6.100 Million)
  - Complete phenomenological investigations.
  - Proceed with in-depth operational demonstrations.

- Eyeball. ($ 6.422 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.

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- Real-Time Battle Damage Assessment (R/T BDA). ($ 15.900 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). ($ 12.000 Million)
  - Complete studies, simulations and initial feasibility experiments.
  - Conduct risk reduction experiments for critical components.

- Dynamic Tactical Targeting (DTT). ($ 9.500 Million)
  - Demonstrate functionality of multi-spectral transponders; demonstrate automated registration algorithms for ISR and in-situ sensors.
  - Develop models for selected in-situ sensors.
  - Initiate fusion experiments of Intelligence, Surveillance and Reconnaissance (ISR) and in-situ sensors.
  - Demonstrate adaptive allocation of ISR sensor resources to enable: efficient search profiles, deployment of additional state change detectors, and track maintenance of objects/targets.
  - Develop interface definition of the transportable DTT Testbed to an operational system with Tactical Exploitation System (TES) functionality.

- 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.
  - Define high performance embedded computing architecture to enable rapid memory access, and develop radar design for advanced airborne sensor platforms supporting this architecture.
  - Initiate planning for advanced algorithms for real-time demonstration.
  - Initiate development for real-time software.

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(U) Other Program Funding Summary Cost:

- Not Applicable.

(U) Schedule Profile:

Plan	Milestones
Foliage Penetration (FOPEN)	
Sep 01	MSET re-host to SAIP residual for field demonstrations.
Nov 01	Verify FOPEN SAR automatic target detection and cueing.
Dec 02	Complete user evaluation of FOPEN SAR operational utility.
Affordable Moving Surface Target Engagement (AMSTE)	
Aug 01	Complete NTsim Link 16 terminal simulator.
Sep 01	AMSTE initial airborne precision fire control and engagement field demonstration.
Sep 01	Complete Link-16 Experiments.
Sep 02	AMSTE live weapons demonstration and track maintenance integrated field experiment.
Aug 03	AMSTE end-to-end system operational demonstration with BM/C3 integration and full threat dynamics.
Eyeball	
Jun 01	Complete Eyeball spatial-spectral-polarimetric architecture trades and target identification concept definition.
Oct 01	Complete Eyeball preliminary/experimental designs. Complete sensor limits report.
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.
Organic Ground Moving Target Identification (OGMTI)	
May 01	Test OGR in tropical forest environment.

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Aug 01 Test OGR deciduous forest in summer conditions.
Jan 02 Test OGR deciduous forest in winter conditions.
Jun 02 Demonstrate OGR operational utility.

Real-Time Battle Damage Assessment (R/T BDA)
May 01 Complete R/T BDA weapon-deployed sensor conceptual design.
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 R/T BDA experiment/demonstration design.

Tactical Targeting Network Technologies (TTNT)
Dec 01 Complete TTNT common tasks and distribute results to primes.
Sep 02 Down select the prime contractors to enter phase two of TTNT.

Dynamic Tactical Targeting (DTT)
Feb 02 Complete selection of appropriate in-situ sensors for the DTT program.
Apr 02 Complete preliminary design of the transportable DTT testbed.

KASSPER
Apr 02 Monostatic Radar Data Collection.
Aug 02 Real-Time Algorithm Preliminary Design Review.