RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							DATE February 2007	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development			R-1 ITEM NOMENCLATURE Guidance Technology PE 0603768E					
COST (In Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Total Program Element (PE) Cost	87.989	142.826	127.777	121.704	110.969	101.597	103.597	103.597
Guidance Technology GT-01	40.773	53.464	44.856	30.707	30.500	30.000	30.000	30.000
Classified GT-CLS	47.216	89.362	82.921	90.997	80.469	71.597	73.597	73.597

(U) Mission Description:

(U) The Guidance Technology program element is budgeted in the Advanced Technology Development Budget Activity because it is developing system oriented technologies that will improve our ability to navigate weapon systems with more precision and increase the capability to meet current and emerging threats.

(U) The Guidance Technology project will increase the ability of Global Positioning System (GPS) users to operate effectively in the presence of enemy jamming; to increase the versatility of navigation systems applications by developing microelectromechanical 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. 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 project.

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(U) Program Change Summary: *(In Millions)*	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget	101.797	157.367	159.094	155.760
Current Budget	87.989	142.826	127.777	121.704
Total Adjustments	-13.808	-14.541	-31.317	-34.056
Congressional program reductions	-10.000	0.000		
Congressional increases	0.000	-14.541		
Reprogrammings	-1.200			
SBIR/STTR transfer	-2.608			

(U) Change Summary Explanation:

FY 2006	The decrease reflects the SBIR/STTR transfer, a reprogramming action to support the Department's Advanced Concept Technology Demonstration program, and the Section 8040 rescission.
FY 2007	The decrease reflects an execution adjustment and a decrease for Section 8106 Economic Assumptions.
FY 2008/2009	The decrease reflects the ending of Advanced Gyroscopes and reduced funding in navigation programs that will begin transitioning in this timeframe.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development			R-1 ITEM NOMENCLATURE Guidance Technology PE 0603768E, Project GT-01					
COST (In Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Guidance Technology GT-01	40.773	53.464	44.856	30.707	30.500	30.000	30.000	30.000

(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. Thrusts are included in this project to improve our ability to navigate when the Global Positioning System (GPS) is jammed or otherwise unavailable; to increase the versatility of navigation systems applications by developing microelectromechanical 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) Program Accomplishments/Planned Programs:

	FY 2006	FY 2007	FY 2008	FY 2009
MEDUSA	10.773	13.005	15.000	15.000

(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 Electro Optical-Infrared (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 component technologies such as high power IR laser sources, advanced IR detectors, and fibers for high power IR transmission; and (3) develop and demonstrate an end-to-end MEDUSA system. The MEDUSA technology is planned for transition to the Air Force and Army at the conclusion of technology development and flight demonstration, which is anticipated to be completed during FY 2011.

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(U) Program Plans:
- Developed and evaluated MEDUSA countermeasure and classification techniques and conducted phenomenological measurements.
- Fabricated and evaluated initial critical component technologies.
- Continued refinement of MEDUSA system designs.
- Built and demonstrated, from a tower, the breadboard MEDUSA design concept against realistic targets and environments.
- Fabricate and evaluate full-scale focal plane arrays and supporting technologies to support flight domain objectives.
- Build and flight test a MEDUSA brassboard design against realistic targets and environments.

	FY 2006	FY 2007	FY 2008	FY 2009
Advanced Gyroscopes	4.000	0.000	0.000	0.000

(U) The Advanced Gyroscopes program investigated the feasibility of a very high-accuracy gyroscopes and other technologies to provide extremely precise navigation, with a goal of reducing noise error to 10^{-5} degree/hour or less. This would enable more robust operations in several applications—from underwater (including covert submarine operation and littoral navigation around obstacles) to outer space (from space flight to precise, autonomous satellite positioning). Technical challenges included the exploitation of quantum effects, such as correlated photons and atom interference effects, as well as gravity and gradiometer based technologies.

(U) Program Plans:
- Developed concepts for achieving the required accuracy.

	FY 2006	FY 2007	FY 2008	FY 2009
Precision Inertial Navigation Systems	5.000	9.259	6.000	3.000

(U) The Precision Inertial Navigation Systems (PINS) program will develop an entirely new class of inertial navigation instruments using atomic inertial force sensors. These sensors utilize the quantum-mechanical wave-like nature of atoms in the atomic analogue of an optical

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interferometer to provide unprecedented sensitivity to accelerations and rotations. The atomic sensors will further be used to measure the local gravitational field gradient to ensure that instrument alignment is properly maintained throughout vehicle maneuver, thus mitigating gravity-induced navigation errors. Initial program efforts will focus on developing fundamental technology components upon which future systems would be constructed. The PINS technology is planned for transition to the Navy and Air Force at the conclusion of Phase 3, which is anticipated to be completed by FY 2009.

(U) Program Plans:

- Develop and demonstrate an inertial navigation system with positional bias drift rate below 5 meters/hour.
- Develop compact narrow-linewidth, tunable 780 nm laser sources with large modulation bandwidth via monolithic solid-state microchip design.
- Demonstrate motion-compensated gravity gradiometer.
- Develop integrated hardware approaches for accurate navigation in densely built urban areas based on image matching.
- Develop and demonstrate technologies for undersea navigation commensurate with the needs of combat swimmers.

	FY 2006	FY 2007	FY 2008	FY 2009
Robust Surface and Sub-Surface Navigation (RSN/SSN)	11.500	15.700	12.000	5.000

(U) The Robust Surface and Sub-Surface Navigation (RSN/SSN) program will provide the U.S. Warfighter with the ability to navigate effectively when the Global Positioning System (GPS) is unavailable due to hostile action (e.g. jamming) or blockage by structures and foliage. The RSN/SSN program will use signals of opportunity and specialized signals from a variety of ground-, air-, and space-based sources and judiciously placed low frequency RF beacons; these will be received on the Warfighter's forthcoming software defined radios, and will use specially tailored algorithms to determine position. Other signals such as the Earth's magnetic field (micro deviations), cyclic variations in the Earth's gravitational field due to tidal motion, will also be evaluated. The greater strength and diversity of these signals will provide coverage when GPS is denied due to lack of penetration into buildings and underground, and when severe multipath is a problem. This is a two part program: (1) cataloging and assessing of potential exploitable signals followed by analysis and performance modeling and hardware-based concept validation and (2) designing, testing, and demonstrating of a (non-form-fit) prototype receiver(s) and algorithms for geolocation using the signals

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of opportunity. The RSN/SSN technology is planned for transition to United States Special Operations Command, the U.S. Army and the U.S. Air Force by FY 2010.

(U) Program Plans:
- Evaluated feasibility of candidate approaches using modeling, analysis, and simulation.
- Developed critical RSN/SSN technologies and conducted phenomenological measurements to validate the down-selected concepts.
- Completed design and component-level testing of SSN system.
- Developed and conducted performance analysis of innovative algorithms for SSN that enhance form/fit of user receiver.
- Design, fabricate, and test functional prototype systems for above-ground and underground use.
- Field test and demonstrate the functional prototype in realistic environments.
- Perform technical risk mitigation experiments and analysis on the bimorph based magnetic sensors, the piezo-electric driving motors and signal and control processing algorithms.
- Integrate technologies into a micro sensor and radiometer structure.

	FY 2006	FY 2007	FY 2008	FY 2009
Navigation-Grade MEMS Inertial Measurement Unit (IMU)	9.500	15.500	11.000	5.000

(U) The Navigation-Grade MEMS Inertial Measurement (IMU) program will develop micro-scale accelerometers and gyros with navigation-grade performance that use only milli-watts of power. The program will transcend traditional single mass-spring methods for navigation sensing and will explore alternative approaches, such as multiple, interconnected mass-spring systems, micro-levitated spinning structures, micro-optical readout mechanisms, atomic interferometric readout mechanisms, and fluidic contortions. This program will transition by industrial performers by developing wearable inertial measurement units (IMUs) for dismounted warfighters capable of GPS-denied navigation for lengthy periods; small IMUs for unmanned air and underwater vehicles, and for guidance of small, long-range munitions—all of which will go into DoD systems.

(U) Program Plans:
- Attain 3D resonator structures (e.g., spheres, full wine-glass structures).

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- Develop levitation methods.
- Develop fluid contortion sensing.
- Develop micro-environmental control.
- Control electronics integration.

	FY 2006	FY 2007	FY 2008	FY 2009
Active Electrol-Optical Mapping and Navigation System (AONS)	0.000	0.000	0.856	2.707

(U) The Active Electrol-Optical Mapping and Navigation System (AONS) program will provide GPS-denied navigation and detailed building interior mapping to soldiers operating in urban environments. AONS will employ electro-optic system strengths in image registration and precision range to track and map a soldier's position continuously. Using image-flow methods, a compact, power-efficient camera and laser radar system will track the imagery from frame-to-frame and estimate camera pose and position information to provide the soldier a very precise determination of current position as well as a continuously updated map of the building or underground facility (UGF) being traversed. This same system will make real-time estimates of range and relative position of objects in the scene, and will provide real-time position estimates outside under GPS-denied conditions in urban, mountainous and foliated areas given access to a high-resolution terrain map of the area. This system would match small-scale features, such as shrubs, trees and small buildings, to features in the map and provide real-time estimates of the soldier's location within that map. The capability will be transitioned to the U.S. Army via PEO Soldier and USSOCOM starting in FY 2010.

(U) The primary technical challenges are the development of compact, integrated high-resolution passive EO/IR and multi-pixel or scanning laser radar systems along with the development of real-time processing capability to provide the soldier up to date position estimates both inside building and outside buildings in GPS denied conditions.

(U) Program Plans:
- Develop initial real-time navigation algorithms based on real and synthetic data.
- Develop an integrated breadboard system with key initial sub-systems including video, laser radar and inertial navigation aids.
- Develop and demonstrate an integrated portable prototype AONS system.

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– Demonstrate real-time navigation and building extraction.

(U) Other Program Funding Summary Cost:

- Not Applicable.