

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 1999		
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development					R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, R-1 #52					
COST (<i>In Millions</i>)	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	Cost To Complete	Total Cost
Total Program Element (PE) Cost	79.319	88.613	97.825	101.376	106.677	77.000	87.000	87.000	Continuing	Continuing
Rapid Strike Force Technology LNW-01	40.304	44.991	50.223	50.176	63.177	27.000	22.000	22.000	Continuing	Continuing
Small Unit Operations LNW-02	39.015	43.622	47.602	51.200	43.500	50.000	65.000	65.000	Continuing	Continuing

(U) Mission Description:

(U) This program element is budgeted in the Advanced Technology Development Budget Activity because it is developing and demonstrating the concepts and technologies that will address the mission requirements of the 21st Century land warrior. Two broad efforts are being pursued in support of this objective: Rapid Strike Force Technology and Small Unit Operations.

(U) The Rapid Strike Force Technology project is developing the technologies necessary for highly mobile, covert transportation and information gathering systems to enhance U.S. early-entry capabilities. The primary thrusts of this project are the Combat Hybrid Power Systems program that is developing and demonstrating hybrid electric power and energy management systems for future combat vehicles; the Reconnaissance, Surveillance, and Targeting Vehicle (RST-V) program will design, develop, test and transition a minimum of four hybrid electric drive, lightweight, highly maneuverable advanced technology demonstrator vehicles to the Services; the Vehicle Self-Protection program will develop technologies to enhance the survivability of mobile ground vehicles against the threat of advanced tactical guided missiles; the Tactical Mobile Robotics (TMR) program that will develop mobile robotic technologies that will enable land forces to dominate battlespace using individual, or teams, of mobile robots in complex terrain; the Mobile Tactical Operation Center program that will provide tactical commanders with current situational awareness, communications and control; the Virtual Strike program that will develop technologies for low-cost, deployable communications deception nodes to support dispersed forces.

(U) The Small Unit Operations project is developing the critical technologies that will enable dispersed units to effectively perform warfighting operations that traditionally have required massed forces. Technology development efforts will focus on a comprehensive awareness capability that provides real-time, essential information for small units and individual warfighters; wireless communication technologies to permit exchange of voice, digital and video data with other systems; geolocation technologies that provide navigation information in built-up, forested and

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E	

mountainous environments; internetted tactical surveillance and targeting sensors to complement information requirements not satisfied by national, theater, and component sensor programs; and automated ultra-miniature imaging and non-imaging sensors.

(U)	<u>Program Change Summary:</u> <i>(In Millions)</i>	<u>FY1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
	Previous President's Budget	80.924	108.490	93.413	89.700
	Current Budget	79.319	88.613	97.825	101.376

(U) **Change Summary Explanation:**

FY 1998 Decrease reflects minor repricing and SBIR reprogramming.
 FY 1999 Decrease reflects impact of congressional program and undistributed reductions and minor below threshold reprogrammings.
 FY 2000/01 Increases reflect net effect of addition of Mobile Tactical Operation Center; initiation of Virtual Strike program; repricing of the Small Unit Operations program; and completion of the Combat Hybrid Power Systems Program in FY 2001.

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 1999		
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development					R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01					
COST (<i>In Millions</i>)	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	Cost to Complete	Total Cost
Rapid Strike Force Technology LNW-01	40.304	44.991	50.223	50.176	63.177	27.000	22.000	22.000	Continuing	Continuing

(U) Mission Description:

(U) The emerging US vision of future land warfare places strong emphasis on technology supporting early entry of light, efficient, land forces. This project is developing technologies that enable mobile and survivable systems for efficient command and control, mobility, surveillance, targeting and reconnaissance, which are important aspects of an early-entry capability. The project consists of: Combat Hybrid Power Systems (CHPS); Helicopter Active Noise and Vibration Control (HANVC); Reconnaissance, Surveillance, and Targeting Vehicle (RST-V); Tactical Mobile Robotics (TMR); Virtual Strike; Vehicle Self-Protection (VSP); and a Mobile Tactical Operation Center (M-TOC). The CHPS, RST-V, M-TOC and TMR programs are closely coordinated with the US Army, Navy, and Marine Corps, and with DARPA's Electric Vehicle (EV-01) and Small Unit Operations (LNW-02) projects.

(U) The Combat Hybrid Power System program will develop enabling technologies and conduct demonstrations of an integrated hybrid electric power system that provides power and energy management for all of the electric subsystems throughout future combat vehicles. Hybrid electric power is an essential enabling technology for future combat vehicles given the number of electrically powered subsystems planned for implementation. The hybrid electric power system will consist of an engine/alternator, sized for average power demand, energy storage and power averaging components which provide both continuous and pulsed power, distribution networks, subsystem controls, and power conditioning devices. Vehicles of various configurations and for a variety of missions will be simulated to evaluate subsystem requirements, topologies, and military utility. The simulated vehicle concepts will demonstrate greatly reduced noise and thermal signatures; improved mobility, survivability, lethality, and fuel economy; optimized interior layouts; significantly reduced volume and weight. These advantages will result in deployable, affordable combat vehicles that meet mission requirements.

(U) The HANVC program will design, fabricate and demonstrate an Active Rotor Control (ARC) system that should achieve 10dB radiated sound pressure noise reduction, and cancel vibration and noise from the main transmission to reduce maintenance costs and improve passenger comfort.

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01	

(U) The Reconnaissance, Surveillance, and Targeting Vehicle (RST-V) program will design, develop, test/demonstrate, and transition to the Services a minimum of four hybrid electric drive, lightweight, highly maneuverable advanced technology demonstrator vehicles capable of V-22 internal transport. The vehicle will incorporate technological advancements in the areas of integrated survivability techniques and advanced suspension. The vehicle will also host integrated precision geolocation, communication and RST sensor subsystems. Vehicle design efforts will take into consideration, to the extent possible, related technologies evolving from DARPA's Small Unit Operations Project. The RST-V platform will provide a mobile quick deployment and deep insertion capable, multi-sensor, battlespace awareness asset for small unit tactical reconnaissance teams, fire support coordinators, and special reconnaissance forces. Critical components and technologies include a high efficiency, reduced signature hybrid electric propulsion system with increased fuel economy; an advanced suspension to increase cross-country speed, and provide platform stabilization; an advanced integrated survivability suite; and the capability to operate in either a silent watch/silent movement or mechanical mode. The vehicle will incorporate modularized design components to allow for signature management and rapid reconfiguration for mission tailoring and multiple purpose utility. Hardware and lessons learned from this program directly support the Marine Corps-Navy Extending the Littoral Battlespace (ELB) ATD as well as address Joint USMC-SOCOM requirements for the Light Strike Vehicle and TV-RSTA program and HMMWV upgrades. The Marine Corps will develop vehicle concepts and chassis, integrate the DARPA developed components, and conduct vehicle performance tests (PE 0603640M) through participation in scheduled Advanced Warfighting Experiments (AWEs) and Advanced Concept Technology Demonstrations (ACTDs) (e.g. Capable Warrior).

(U) The Tactical Mobile Robotics (TMR) program will develop mobile robotic technologies that will enable land forces to dominate the battlespace through employment of mobile semi-autonomous robot teams performing challenging missions in complex environments (dynamic urban areas, rugged terrain with high obstacle clutter, etc.). TMR will provide DoD organizations with semi-intelligent, cooperating platforms carrying a variety of integrated mission payloads required to conduct activities in risk intensive or inaccessible areas. Operational emphasis is on urban environments and denied areas. Specific robot technologies that will be advanced include: perception, autonomous operation, and advanced locomotion for complex obstacle negotiation. Perception capabilities will include: (a) an on-board multi-sensor perception system capable of detecting at least 80 percent of decimeter-scale terrain hazards and at least 95 percent of meter-scale terrain hazards, both at 20 Hz and (b) multi-source mapping algorithms capable of creating topological maps of urban structures with 90% accuracy. Autonomous operation capabilities will include: (a) coordination of the tactical behavior of a multi-robot team with significant command cycle reduction, and (b) traversal of rugged/complex terrain using 1 command per 100m of travel. Locomotion capabilities will feature portable (sub-meter-scale) vehicles traveling up to 1 m/s over 25 cm steps and decimeter-scale rubble.

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01	

(U) The Vehicle Self-Protection (VSP) program will develop an Ultraviolet (UV) solar blind solid state focal plane array to significantly enhance the survivability of mobile ground vehicles against the threat of advanced tactical guided missiles at greatly reduced cost.

(U) The Virtual Strike program will develop and demonstrate technologies for low cost, deployable communications deception nodes to support dispersed forces. Virtual Strike will employ situational awareness tools to locate and identify enemy and friendly forces, a network of communications spoofing devices to deceive the enemy as to the location and tempo of U.S. forces, electronic warfare techniques to mask U.S. systems or inject false targets into enemy sensor systems, and small autonomous vehicles to support the deployment and movement of the communications and electronic warfare devices. The first phase shall develop concepts for communications deception components that can be adapted to mobile or fixed host platforms.

(U) The Mobile Tactical Operation Center (M-TOC) program will enable the battalion commander to control organic surveillance assets and fire support while on the move. In addition, battlefield situational awareness will be provided by connectivity to division and/or corps operations centers. This program will develop the technology needed to allow high-performance exploitation and fusion of varied data products by the commander. Enhanced visualization and communication programs currently on-going at DARPA will be leveraged.

(U) **Program Accomplishments and Plans:**

(U) **FY 1998 Accomplishments:**

- Combat Hybrid Power Systems (CHPS). (\$ 17.917 Million)
 - Initiated simulation/modeling efforts using specifications for laboratory demonstration hardware to enable hardware-in-the-loop demonstration of virtual prototype.
 - Selected and procured hybrid electric power system subsystems for installation in the Systems Integration Laboratory (SIL).
 - Developed technology and initiated fabrication of selected full-scale engine/alternator, power averaging, power conditioning, and power distribution and control components.

- Helicopter Active Noise and Vibration Control (HANVC) program; Congressional addition to the FY 1998 President's Budget. (\$ 4.998 Million)
 - Fabricated a Mach scale actively controlled rotor for wing tunnel testing.

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01	

- Tested active transmission mounts on a benchtop rig.
- Conducted near full scale fixed wing testing of an actively controlled rotor.
- Conducted testing of eddy current vibration sensors.

- Reconnaissance, Surveillance, and Targeting Vehicle (RST-V). (\$ 6.565 Million)
 - Successfully completed Preliminary Design and conducted Preliminary Design Review for both RST-V contractors.
 - Conducted critical item demonstrations of hybrid electric power system, mobility subsystems, and survivability suites.
 - Evaluated emerging technologies for vehicle survivability, tactical sensing and visualization.
- Tactical Mobile Robotics (TMR). (\$ 10.824 Million)
 - Developed advanced employment concepts for Tactical Mobile Robots.
 - Refined program plan to incorporate emerging user requirements and more challenging mission profiles.
 - Developed basic tele-operated stair climbing platform to support development of advanced multi-input mapping capabilities.
 - Conducted assessment of embedded software systems to perform autonomous tactical decision-making.

(U) **FY1999 Plans:**

- Combat Hybrid Power Systems (CHPS). (\$ 17.073 Million)
 - Install and integrate hybrid electric power components in the Systems Integration Laboratory (SIL).
 - Conduct tests that demonstrate simultaneous operation of pulsed and continuous loads in the laboratory and verify the virtual prototype models.
 - Complete design and initiate fabrication of advanced, high risk power system components – critical enabling technologies.
 - Demonstrate hardware-in-the-loop future combat vehicle virtual prototype to support technology development.
- Reconnaissance, Surveillance, and Targeting Vehicle (RST-V). (\$ 6.293 Million)
 - Complete Critical Design and conduct Critical Design Review of both RST-V team designs.

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01	

- Down select to one contractor.
- Finalize design and conduct Fabrication Readiness Review.
- Refine development of automotive subsystems.
- Evaluate emerging technologies for high data rate covert communications.

- Tactical Mobile Robotics (TMR). (\$ 17.625 Million)

- Refine advanced employment concepts to exploit portable robot potential and accommodate expanded user interest.
- Demonstrate breadboard robot perception, autonomy, and obstacle negotiation (stair climbing) in challenging mission scenarios.
- Complete and evaluate competing designs for integrated robotic system.
- Refine system design and employment plans to exploit progress made with enabling technologies and accommodate multiple collaborating platform employment where practical.
- Evaluate advanced communication and control techniques.

- Vehicle Self-Protection Program (VSP). (\$ 4.000 Million)

- Initiate development of an Ultraviolet (UV) solar blind solid state focal plane array to significantly enhance the survivability of mobile ground vehicles against the threat of advanced tactical guided missiles at greatly reduced cost.

(U) **FY 2000 Plans:**

- Combat Hybrid Power Systems (CHPS). (\$ 8.819 Million)

- Install the completed, advanced, high-risk hybrid electric power system components in the Systems Integration Laboratory (SIL).
- Continue test and evaluation of integrated hybrid electric power system and subsystems.
- Initiate transition of Combat Hybrid Power Systems (CHPS) program to U.S. Army.

- Vehicle Self-Protection Program (VSP). (\$ 5.886 Million)

- Demonstrate low defect epitaxial material compatible for photodetectors with high sensitivity operating in the solar-blind region of the spectrum (240-300 nm).

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01	

- Virtual Strike. (\$ 2.000 Million)
 - Develop a system concept, define system architecture, and estimate performance against threats. Build a brassboard counter communications prototype and bench test against Small Unit Operations (SUO) radio equipment. Determine optimum deployment methods.

- Mobile Tactical Operations Center (M-TOC). (\$ 7.000 Million)
 - Initiate development of decision aids.
 - Assess performance of advanced display technologies in moving platform.
 - Develop requirements for connectivity, exploitation, and interface protocols.
 - Initiate development of a lightweight phased array antenna to be incorporated into the vehicle.

- Tactical Mobile Robotics (TMR). (\$ 15.719 Million)
 - Initiate development of fully functional tactical robotic platforms.
 - Integrate enabling technologies into functional platforms.
 - Refine demonstration and transition plans commensurate with success in system design and multi-platform collaboration.

- Reconnaissance, Surveillance, and Targeting Vehicle (RST-V). (\$ 9.799 Million)
 - Perform wheelmotor qualification tests.
 - Roll out vehicles 1 and 2.

- Advanced Concepts Evaluation (\$ 1.000 Million)
 - Conduct technology assessment and feasibility testing of advanced rapid strike force concepts including precision guided munitions, force-on-force modeling, covert autonomous sensors, and future unmanned vehicle systems.

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01	

(U) **FY 2001 Plans:**

- Combat Hybrid Power Systems (CHPS). (\$ 5.676 Million)
 - Complete test and evaluation of fully integrated hybrid electric power system and subsystems.
 - Complete test and evaluation of advanced, high-risk hybrid electric power system components in a laboratory demonstration.
 - Transition CHPS program to U.S. Army.

- Vehicle Self-Protection Program (VSP). (\$ 4.000 Million)
 - Demonstrate solar-blind detector array with 128 x 128 pixels.

- Mobile Tactical Operations Center (M-TOC). (\$ 16.000 Million)
 - Continue phased array antenna for low radar cross-section communication.
 - Integrate advanced displays into test vehicle.
 - Continue development of decision aids.

- Virtual Strike. (\$ 5.000 Million)
 - Integrate equipment into platform, build three to five integrated systems, and conduct proof of concept field test in conjunction with SUO field tests.

- Tactical Mobile Robotics (TMR). (\$ 13.000 Million)
 - Complete integrated robotic system development and testing.
 - Conduct operational demonstrations with integrated systems.
 - Initiate transition to military departments.

- Reconnaissance, Surveillance, and Targeting Vehicle (RST-V). (\$ 6.500 Million)
 - Deliver vehicles 1 & 2 for participation in United States Marine Corps (USMC) Advanced Warfighting Experiment.

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01	

(U) Other Program Funding Summary Cost:

	<u>FY1998</u>	<u>FY1999</u>	<u>FY2000</u>	<u>FY2001</u>
PE 0603640M Marine Corps Advanced Technology	2.7	2.8	3.0	2.7
PE 0603005A Combat Vehicle and Automotive Advanced Technology	1.0	5.0	3.0	

(U) Schedule Profile:

<u>Plan</u>	<u>Milestones</u>
Jun 99	Demonstrate hardware-in-the-loop virtual prototype of combat hybrid power system (CHPS).
Jun 99	Conduct interim technology demonstrations in robotic perception, autonomous navigation, and locomotion on surrogate vehicles and complete breadboards for selected TMR platforms (TMR).
Aug 99	Complete Concept of Operations for Battalion level command and control center (Mobile Tactical Operation Center (M-TOC))
Sep 99	Define system design for selected platforms (TMR).
Dec 99	Electric drive checkout (RST-V).
Jan 00	Conduct Preliminary Design Review. (PDR) of selected TMR platforms and begin fabrication of same (TMR).
Jan 00	Initiate designs for decision aids and communication systems (M-TOC).
Jul 00	Integrate advanced components and demonstrate fully integrated combat hybrid power system laboratory (CHPS).
Jun 00	Vehicle 2 rollout (RST-V).
Jun 00	Complete assessment of human performance degradation due to motion (M-TOC).
Jul 00	Conduct final technology demonstration and Critical Design Review (CDR) for selected TMR platforms (TMR).
Jul 00	Define communication deception node system architecture.
Sep 00	Conduct Preliminary Design Review (PDR) for low radar cross section antenna and decision aids (M-TOC).
Oct 00	Deliver vehicles 1 & 2 (RST-V).
Jan 01	Demonstrate RST-V system capabilities in Advanced Warfighting Experiment (AWE). (RST-V).
Mar 01	Configure system for Service transition (Combat Hybrid Power System (CHPS)).
Mar 01	Demonstrate Avalanche Photodetector (APD) array with 100 amps/watt responsivity and low dark current.

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01	

- Mar 01 Conduct Critical Design Review (CDR) for low radar cross section antenna and decision aids. (Mobile Tactical Operation Center (M-TOC)).
- Jun 01 Integrated Survivability demonstration of Reconnaissance, Surveillance, and Targeting Vehicle (RST-V).
- Jul 01 Complete design of selected communications deception node components.
- Jul 01 Complete operational demonstrations of Tactical Mobile Robotic (TMR) systems. Initiate transition and technology transfer plans (TMR).

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 1999		
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development					R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-02					
COST <i>(In Millions)</i>	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	Cost to Complete	Total Cost
Small Unit OperationsLNW-02	39.015	43.622	47.602	51.200	43.500	50.000	65.000	65.000	Continuing	Continuing

(U) Mission Description:

(U) The Services are pursuing new tactical concepts for employing small, easily deployed units as an early entry force to address future contingencies. Their objective is to enable these forces to quickly control a large battlespace with dispersed forces, control the operational tempo, engage enemy targets with remote fire, and operate effectively across the spectrum of conflict in severe communications environments. These dismounted forces must be self-sufficient, capable of operating for several days and be sufficiently lean to be quickly inserted anywhere in the world.

(U) Superb situational awareness is critical to the combat effectiveness and survivability of such forces. Each small team must constantly know where it is, where the other teams are and where the enemy and any other threat is located. The Services are developing lightweight radio communications and Global Positioning System (GPS) dependent geo-positioning systems packaged into fielded capabilities such as the Land Warrior System. In addition, advanced standoff sensor systems such as Predator, Global Hawk, and Discoverer II are being developed to monitor the enemy's movements and characterize the battlespace. These capabilities will greatly improve the combat effectiveness of small dismounted forces, but will be limited to operations in open areas under benign conditions. Current communications, navigation and sensor technology is poorly configured to operate in urban areas (outside or inside buildings), in jungles, forests or mountainous terrain. Communications technology is susceptible to enemy jamming or unintentional radio interference and is not covert to intelligence operations. Extant sensors and exploitation capabilities are limited to broad area surveillance of vehicles and facilities; data is not mined and distributed to forces at the lowest echelon.

(U) The objective of the Small Unit Operations Program is to develop critical technologies that will enable small dismounted forces to effectively fight anywhere, anytime. The technology needs are: semi-automated maneuver and strike/fire planning and re-planning that can be employed by commanders who are physically separated but need to be virtually collocated; automated fusion and mining of information sources to provide a "bubble" of awareness over each warrior and team describing the relevant situation; accurate geographic position estimation, other than GPS, which works in all environments; and radio links and ad hoc networked communications that "glue" the components together, operates in any environment, is covert and is resistant to interference. In addition, these technologies must not significantly increase the dismounted force's mass and power burden.

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-02	

(U) The Situation Awareness System (SAS) will integrate these technologies into a 1 kg module (plus 0.5 kg per day for the power source) worn by the individual warrior. The DARPA module will be interoperable with the Army Land Warrior equipment and provide much greater functionality at significantly less weight. The warrior module will provide the communications and computing power to fully interconnect the dismounted force and enable situation awareness information to be distributed, as well as support continuous planning and combat execution. The Geolocation Technology Program will develop and demonstrate precision miniature clocks, a low-power Global Positioning System (GPS) receiver/processor (2 joules per fix) and a digital LORAN receiver to provide the accurate navigation and targeting needed for small unit operations.

(U) The Situation Awareness System (SAS) program will investigate the critical SAS performance parameters with in-depth experiments. It will provide user-centered design input for developers and provide an independent assessment of the SAS design. The experiments will be focused to evaluate the sensor employment, validate network robustness and reliability, and conduct a scenario-focused evaluation of geolocation and navigation requirements in urban, forested, and mountainous terrain. It will also acquire and codify knowledge of dispersed land forces tactics to develop decision aids and evaluate the utility of the aids for small units. Specialized tools will be developed to generate scenario-synchronized data for development and evaluation of the Situation Awareness System functions. The program will coordinate the use of testing infrastructure to conduct evaluations and assessment and will employ a combination of military and technical subject matter experts, computer modeling and simulation tools, and laboratory and field exercises, to provide independent validation of the SAS functionality.

(U) The Tactical Sensors program will develop new sensor system technologies that will provide the warfighter with a capability to detect, track, and classify mobile tactical targets and to characterize fixed, man-made structures. These sensor systems provide a local, in-situ sensing capability near high value targets or at choke points in denied areas. Information provided by these sensors can be fused with other longer range space, airborne, and ground sensor systems to enhance the aggregate surveillance and tracking capabilities of US forces. Applications include surveillance, cueing, precision targeting, intelligence, and battle damage assessment with respect to time critical, mobile targets (vehicles and humans) and to fixed, man-made structures (surface and underground facilities).

(U) The Laser Acoustic Sensors program will develop a completely new class of laser acoustic sensors for military surveillance and targeting applications. These sensors will provide surveillance, target detection, tracking, classification, cueing, and bomb damage assessments at distances 10X greater than current capabilities. The acoustic sensor will use a virtual acoustic array generated by angle scanning and range gating a laser beam in the atmosphere. Natural aerosols in the virtual array are displaced by the acoustic pressure wave generated by the target, and thus provide a phase modulated backscatter of the laser energy that is detectable by the receiver. A recent breakthrough in defining atmospheric turbulence cells with unique, fine structure doppler spectrum permits visibility and access to the target acoustic signature sideband structure.

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-02	

(U) **Program Accomplishments and Plans:**

(U) **FY 1998 Accomplishments:**

- Conducted field experiment of geolocation integrated brassboard system for restricted environment geolocation. (\$ 3.100 Million)
- Conducted demonstration of unique time difference of arrival breadboard for 3-meter indoor geolocation accuracy. (\$ 0.300 Million)
- Assessed advanced concepts and technologies for dispersed land forces applications. (\$ 2.200 Million)
- Conducted field experiments and demonstrated technologies at CINC and Warfighter exercises. (\$ 4.456 Million)
- Continued development of situation awareness technologies focusing on plan execution and user interface functionality. (\$ 1.500 Million)
- Continued development of tactical communications capability. (\$ 4.159 Million)
- Developed and demonstrated Situation Awareness System detailed design. (\$ 12.100 Million)
- Continued development of internetted remote control sensors to detect, localize and characterize targets. (\$ 2.500 Million)
- Continued development of surveillance and targeting sensors systems for dispersed operations. (\$ 8.700 Million)

(U) **FY 1999 Plans:**

- Assess advanced concepts and technologies for dispersed land forces applications. (\$ 1.100 Million)
- Conduct field experiments and demonstrate technologies at CINC and Warfighter exercises. (\$ 3.188 Million)

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-02	

- Complete developments for the situation awareness and real time tasking and control technologies. (\$ 1.700 Million)
- Complete technology development for tactical communications capability. (\$ 2.251 Million)
- Complete evaluation of enabling technologies associated with Situation Awareness System (SAS) design and conduct breadboard demonstration of critical communications and geolocation technologies. (\$ 5.000 Million)
- Complete detailed design of SAS and begin development of Situation Awareness brassboard system. (\$ 14.900 Million)
- Continue development of internetted remote control sensors to detect, localize and characterize targets. (\$ 4.829 Million)
- Continue development of surveillance and targeting sensors systems for dispersed operations, including laser acoustic sensor phenomenology modeling and breadboard design. (\$ 10.654 Million)

(U) FY 2000 Plans:

- Complete SAS detailed hardware and software design. (\$ 12.650 Million)
 - Complete development of the Individual Warfighter Situation Awareness System (IWSAS), Warfighter Tactical Associate (WTA)-Base, WTA Mobile, and Relay/Router/Beacon detailed hardware design.
 - Complete design of software modules for IWSAS, WTA-Base, WTA-Mobile, Relays, and network protocols.
- Complete Individual Warfighter/Warfighter Tactical Associate software coding. (\$ 6.100 Million)
 - Complete IWSAS, WTA-Base, WTA-Mobile, Relays, and network code development and testing.
 - Complete situation awareness (planning, tasking, sensor control, navigation, and alerts) application software coding and testing.
- Complete brassboard fabrication of the major SAS elements (IWSAS, WTA, and Relays). (\$ 1.600 Million)
- Complete development of sensor and weapon simulants for field tests. (\$ 1.000 Million)

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-02	

- Integrate and perform in-house engineering tests on brassboard SAS. (\$ 1.000 Million)
 - Conduct performance assessment of Situation Awareness System (SAS) Phase 3 brassboard design. (\$ 7.900 Million)
 - Verify that Individual Warfighting Situation Awareness System (IWSAS), Warfighter Tactical Associate (WTA) and Relay Radio Frequency (RF) propagation in multipath, jamming and open environments meets 99% service availability objective.
 - Measure SAS network capacity, loading factors, data rates, and protocol performance.
 - Verify geolocation accuracy and navigation performance in urban and field environments.
 - Assess situation awareness display functionality and human – machine interface utility.
 - Develop preliminary detailed demonstration plan for FY 2001 SAS operational demonstration. (\$ 1.000 Million)
 - Continue assessment of advanced concepts and technologies for dispersed land forces applications. (\$ 0.800 Million)
 - Begin fabrication of 100 Individual Warfighting Situation Awareness System (IWSAS), 10 Warfighter Tactical Associate (WTA) Mobiles, 1 WTA-Base, 100 tactical sensors, and 50 tactical relays. (\$ 5.753 Million)
 - Continue development of internetted remote control sensors to detect, localize and characterize targets; continue development of surveillance and targeting sensors systems for dispersed operations. (\$ 6.859 Million)
 - Continue laser acoustic breadboard sensor and initiate brassboard development. (\$ 2.940 Million)
- (U) **FY 2001 Plans:**
- Complete fabrication of 100 IWSAS, 10 WTA-Mobiles, 1 WTA-Base, 100 tactical sensors, and 50 tactical relays. (\$ 16.000 Million)
 - Integrate IWSAS, WTA-Mobile, and WTA-Base with external legacy communications, data, and sensor equipment. (\$ 8.800 Million)
 - Test integrated Situation Awareness System (SAS). (\$ 3.500 Million)

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-02	

- Conduct performance assessment of final Situational Awareness System (SAS) Phase 3 design; Measure Individual Warfighting System Situational Awareness System (IWSAS), Warfighter Tactical Associate (WTA) and Relay Radio Frequency (RF) propagation in multipath, jamming and open environments meets 99% service availability objective. (\$ 8.500 Million)
- Complete development of detailed demonstration scenarios to test and evaluate performance of the Situation Awareness System (SAS) under operational conditions; perform setup of SAS field demo. (\$ 2.000 Million)
- Develop training materials and conduct soldier training for field demo. (\$ 1.400 Million)
- Continue development of internetted remote control sensors to detect, localize and characterize targets and continue development of surveillance and targeting sensors systems for dispersed operations. (\$ 8.000 Million)
- Complete laser acoustic brassboard and initiate 2D fieldable sensor development. (\$ 3.000 Million)

(U) Other Program Funding Summary Cost:

- Not Applicable.

(U) Schedule Profile:

<u>Plan</u>	<u>Milestones</u>
May 99	Conduct Situation Awareness System (SAS) critical technology proof-of-concept demonstrations.
Jun 99	Situation Awareness System Requirements Review.
Jul 99	Demonstrate real time mini-imaging.
Jul 99	Brassboard testing and evaluation of internetted micro unattended ground sensor system.
Aug 99	Brassboard demonstration of broadband targeting sight.
Aug 99	Demonstrate integrated sensors, tasking and control brassboard.
Nov 99	Demonstrate brassboard Situation Awareness System network design.
Dec 99	Demonstrate laser acoustic signal processing and wind tests.

UNCLASSIFIED

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-02	

- Feb 00 Complete Situational Awareness System (SAS) Critical Design Review.
- May 00 Demonstrate Miniature Infrared Camera (MIRC).
- May 00 Complete Situational Awareness System (SAS) software coding.
- Jun 00 Complete SAS sensor and weapon simulant.
- Jul 00 Complete brassboard SAS integration and test.
- Aug 00 Demonstrate brassboard integrated micro-Unattended Ground Sensors (UGS) system.
- Sep 00 Demonstrate laser acoustic final breadboard.
- Mar 01 SAS components fabricated.
- Mar 01 Complete detailed field demonstration plan.
- Jun 01 Conduct demonstration readiness review.
- Sep 01 Demonstrate laser acoustic final brassboard.
- Sep 01 Complete micro-Unattended Ground Sensors (UGS) field demonstration tests.