

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)								DATE February 1999		
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602270A Electronic Warfare (EW) Technology						
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	15927	16116	17487	18082	18433	18797	21054	22196	Continuing	Continuing
A442 Tactical Electronic Warfare Technology	8781	9353	9595	9924	10133	10369	11481	12085	Continuing	Continuing
A906 Tactical Electronic Warfare Techniques	7146	6763	7892	8158	8300	8428	9573	10111	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program investigates electronic warfare (EW) technologies for current and future systems. The efforts in EW will enable the Army to deny the enemy use of the radio spectrum for command, control, communications and computer intelligence purposes, and provide a decisive advantage to our operational forces against the full range of traditional and non-traditional threat forces. Electronic countermeasures (ECM) and self protection developments will protect Army forces from a broad range of radio frequency (RF) surveillance/tracking systems, imaging radars, advanced RF/ electro-optical infrared (EOIR) missiles, and smart munitions. Applied research is also being done in the area of using automated intelligence fusion techniques and developing automated battlefield asset management tools. Work in this program will lead to winning the battlefield information war by controlling the electromagnetic spectrum and conducting successful electronic disruptive/destructive measures to threat mission planning. Work in this program element is consistent with the resource constrained Army Science and Technology Master Plan (ASTMP), Science and Technology Objectives (STOs) and the Army Modernization Plan, and adheres to Tri-Service Reliance Agreements on intelligence and electronic warfare. It is related to and fully coordinated with efforts in PE 0602782A (Command, Control and Communications (C3) Technology), PE 0602709A (Night Vision and Electro-Optics Technology), PE 0603789F (C3 Intelligence Technology Development), PE 0603270A (Electronic Warfare Technology), PE 0604270A (Electronic Warfare Development), and PE 0603745A (Tactical Electronic Support Systems - Advanced Development) in accordance with the ongoing Reliance joint planning process. This program is primarily managed by Communications-Electronics Research, Development and Engineering Center (CERDEC), Fort Monmouth, NJ.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

DATE **February 1999**

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602270A Electronic Warfare (EW) Technology

B. Program Change Summary:	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
Previous President's Budget (<u>FY 1999</u> PB)	18925	16249	17699	18221
Appropriated Value	19528	16249		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-603	-133		
b. SBIR / STTR	-141			
c. Omnibus or Other Above Threshold Reductions	-2857			
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since <u>FY 1999</u> PB			-212	-139
Current Budget Submit (<u>FY 2000 / 2001</u> PB)	15927	16116	17487	18082

Program Change Summary Explanation: FY1998 funds in project A936 (-2857) reprogrammed to PE 0604270A, Electronic Warfare Development to more accurately reflect the work being accomplished in support of the Shortstop Electronic Protection System.

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)								DATE February 1999			
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602270A Electronic Warfare (EW) Technology					PROJECT A442		
COST (In Thousands)		FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A442	Tactical Electronic Warfare Technology	8781	9353	9595	9924	10133	10369	11481	12085	Continuing	Continuing
<p>Mission Description and Justification: This project performs applied research on electronic warfare sensor and countermeasure (CM) technologies for self protection of air and ground platforms, area protection against radar-directed weapons (i.e., jamming of enemy counter mortar/counter battery radars), combat surveillance and target acquisition. The following technology areas are investigated:</p> <ul style="list-style-type: none"> - Infrared countermeasures (IRCM) technologies that provide air and ground platforms with the capability to detect and jam heat-seeking surface-to-air missiles and anti-tank guided missiles with active infrared (IR) sources, or to decoy them with flares or other devices. - Self-protection radar countermeasures/warning technologies that provide air and ground platforms with warning and jamming against radar-directed air defense weapons, and jamming of top attack/smart munitions/ artillery-delivered radio proximity fuses. - Laser warning and countermeasures technologies that provide air and ground platforms with laser rangefinder and designation warning and jamming capability against laser-aided and electro-optically-directed threats including laser beamrider missiles. - Fusion and correlation of missile and radar warning data to assist in the location and identification of threats and increase situation awareness. - Electronic support (ES) technologies that provide the capability to intercept, direction find, and locate current and emerging hostile non-communications emitters for targeting and tactical situational awareness for ground, man-portable and unmanned aerial vehicle (UAV) applications. - Area protection radar countermeasure technologies that provide radar stand-off and stand-in jamming and deception in support of ground forces. <p>FY 1998 Accomplishments:</p> <ul style="list-style-type: none"> • 2900 - Tested low cost specific emitter identification, location and targeting techniques in coordination with Naval Research Laboratory Survivability Integration Laboratory (SIL) established link to Ft. Rucker's aviation testbed for user evaluation and doctrine development for new electronic warfare technologies and capabilities. <ul style="list-style-type: none"> - Completed development of phased array radar digital model to support countermeasure techniques. • 3786 - Developed key technology requirements for a multispectral sensor module for radio frequency (RF) and missile warning to replace multiple sensors on aircraft and vehicles. <ul style="list-style-type: none"> - Completed the tri-service development of the digital advanced "generic" IR missile to support the multispectral countermeasures demonstration. • 2095 - Performed laboratory demonstrations of the low probability of intercept (LPI) appliqué receiver and the high-speed impulse detector. These will enable the common module electronic intelligence (ELINT) system (CMES) to perform rapid detection, characterization and direction finding of low-power impulse emitters. <ul style="list-style-type: none"> - Demonstrated capability to detect and process impulse signals from an airborne platform. - Developed technology to deceive imaging, meteorological, and non-conventional sensors and perform laboratory demonstration of prototype. 											
Project A442		Page 3 of 8 Pages					Exhibit R-2A (PE 0602270A)				

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602270A Electronic Warfare (EW) Technology	PROJECT A442
FY 1998 Accomplishments: (continued)		
<ul style="list-style-type: none"> - Performed experiments to test the use of ELINT systems to cue synthetic aperture radar (SAR) for target detection and imaging over a wide area. Results indicate that mission search times can be reduced by a factor of 200 using this technique. 		
Total	8781	
FY 1999 Planned Program:		
•	3215	<ul style="list-style-type: none"> - Complete development of techniques for precision direction finding of ultra-high frequency (UHF) and millimeter wave (MMW) air defense surveillance and targeting radars. - Verify accuracy of direction finding and specific emitter identification techniques via survivability systems integration lab and joint work with the Naval Research Laboratory (NRL) transition to integrated situation awareness and targeting (ISAT) advanced technology demonstration (ATD). - Enhance jamming techniques against bi-static, low probability of intercept (LPI) and impulse radars. - Conduct field measurements of IR and UV signatures of SAMs and ATGMs.
•	2717	<ul style="list-style-type: none"> - Enhance development, simulation, and testing of infrared countermeasure jamming techniques against multiple imaging infrared, laser designated, and laser beam riding threats. (Coordinated NRL/Air Force Research Laboratory (ARFL) program). - Develop techniques to manage and optimize the combination of infrared laser jamming and decoy/flares countermeasures.
•	1000	<ul style="list-style-type: none"> - Complete design based on USAF C-130 research, of the fiber-optic, remote antenna assembly to improve transmission efficiency between external warning receivers and internal signal processing systems. - Develop low observable, multi-octave antenna technology to provide warning receivers with precision angle of arrival capability to control and direct countermeasures, and to enhance situational awareness, target cueing and emitter identification capabilities.
•	2258	<ul style="list-style-type: none"> - Conduct laboratory demonstrations of the adaptive matched filter receiver to improve the capability of CMES to detect/characterize modern signals in the presence of a heavy conventional signal environment. - Perform laboratory demonstration of electronic support measures (ESM) capability against impulse radars for Program Manager (PM) Signal Warfare. - Address technologies required to provide a modular, full spectrum capable electronic counter measure and electronic counter-counter measure (ECM/ECCM) UAV payload to react quickly to rapidly changing emitter Low probability of Intercept and Low Probability of Detection threats. - Continue development and application of ELINT cueing techniques to enable rapid detection and imaging of high priority targets, battle damage assessment, and threat avoidance over a wide area.
•	163	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs
Total	9353	
FY 2000 Planned Program:		
•	2338	- Design a high speed digital receiver, in conjunction with DARPA, Air force (AF), and Navy laboratories, that will provide the capability to receive, classify and support time difference of arrival (TDOA) emitter location of both radar and communications signals.
Project A442		

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602270A Electronic Warfare (EW) Technology	PROJECT A442
FY 2000 Planned Program: (continued)		
	- Develop ultra wide bandwidth digital RF memory module, utilizing DARPA high-speed analog-to-digital converter technology, to generate signals to deceive and jam imaging radars, low probability of intercept, and frequency hopping air defense and surveillance radars. Coordinated development of software with NRL and AFRL for digital RF memory.	
• 1925	- Enhance development of low observable, multi-octave antenna technology for upgrades to RF and missile warning systems. - Conduct survivability integration lab and field tests to refine multi-octave antenna design, and to support development of countermeasure management techniques. - Conduct trade-off analyses and simulations, and develop design alternatives for combining two or more of the missile, laser and radar warning sensors in a single modular package for application to both aircraft and ground vehicles.	
• 2934	- Develop non mechanical laser beam steering techniques to improve accuracy and stability of jamming energy, simplify design, and reduce cost of laser based infrared countermeasure systems. - Develop multi-band ultraviolet and infrared countermeasure techniques to defeat emerging multispectral surface-to-air and air-to-air missiles. - Develop infrared countermeasures techniques to advanced anti-tank guided missile.	
• 2398	- Address packaging, antenna, and signal processing technologies for the development of small, lightweight, remotely reconfigurable electronic support (ES) capability which employs sensor cross-cueing for precision geolocation of high value targets. - Develop passive millimeter wave visualization technology to improve detection of target emitters in a dense signal environment. - Investigate the application of low probability of intercept (LPI) algorithms to detect and geolocate spread spectrum emitters. - Perform simulation and modeling of ECM/ECCM effectiveness. Perform waveform analysis for threat emitters and jamming techniques for tactical or short range UAV payloads.	
Total	9595	
FY 2001 Planned Program:		
• 2514	- Enhance high-speed digital receiver that will provide the capability to receive, classify using specific emitter identification (SEI) and support time difference of arrival (TDOA) emitter location of both radar and communications signals. - Continue development of ultra wide bandwidth digital RF memory module required to generate signals to deceive and jam advanced radars. - Develop and test wide bandwidth deception and countermeasure algorithms, waveforms, and modulation techniques to provide tactical countermeasure systems with the capability to degrade or delay the enemy's ability to locate dismounted, mounted, aviation, and forward support units with imaging radars.	
• 1939	- Complete development of low observable, multi-octave antenna technology, test and characterize sensitivity and observability parameters via hardware-in-the-loop simulation. - Develop, integrate, and evaluate component technologies for multi-spectral missile, laser and radar warning sensors in a single modular package for application to both aircraft and ground vehicles.	
Project A442	Page 5 of 8 Pages	Exhibit R-2A (PE 0602270A)

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	0602270A Electronic Warfare (EW) Technology	February 1999 A442
<ul style="list-style-type: none"> • 2989 – Conduct hardware-in-the-loop simulation tests of non-mechanical laser beam steering modules and techniques to improve accuracy and stability of jamming energy, simplify design, and reduce cost of laser based infrared countermeasure systems. <p>FY 2001 Planned Program: (Continued)</p> <ul style="list-style-type: none"> – Develop and evaluate multi-band ultraviolet and infrared countermeasure techniques to defeat emerging multispectral surface-to-air and air-to-air missiles. – Develop and integrate compact modular, multi-band countermeasure laser based on AF developed semiconductor laser technology. – Transition cooperative jamming and decoy/flare techniques to integrated countermeasures technology demonstration. <ul style="list-style-type: none"> • 2482 – Develop electrically reconfigurable antennas for airborne and ground SIGINT platforms. – Integrate spread spectrum receiver technology for eventual transition to countermeasure systems. – Perform research and development to provide electronic support technology to intercept, geolocate, and counter emerging hostile non-communications emitters on the battlefield. – Design ultra-low sidelobe antenna, adaptive power control module, and provide specific emitter identification capability for tactical or short range UAV payloads. <p>Total 9924</p>		
Project A442	Page 6 of 8 Pages	Exhibit R-2A (PE 0602270A)

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602270A Electronic Warfare (EW) Technology				PROJECT A906		
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A906 Tactical Electronic Warfare Techniques	7146	6763	7892	8158	8300	8428	9573	10111	Continuing	Continuing
<p>Mission Description and Justification: This applied research program involves technologies that provide the capability to intercept, direction find (DF) and locate current and emerging threat communications emitters for targeting, tactical situation awareness, and disruption/destruction of enemy command, control and communications (C3) systems. It specifically develops essential electronic attack (EA) components and techniques for advanced jammers and smaller, lower power, lightweight, common modules for advanced systems to counter communications associated with modern threat C3 systems. In addition, it will provide remote capability to intelligence and electronic warfare sensor systems with EA algorithms that enable the disruption, denial or destruction of threat communication signals. These efforts provide critical technology underpinnings for friendly force ownership of the electromagnetic spectrum. Other technology efforts performed under this program involve fusion (automated assimilation and synthesis) of battlefield intelligence data. Research and development will be conducted to provide a joint intelligence, surveillance, and reconnaissance capability at the brigade level to address operational shortfalls. On-going fusion and dissemination efforts will be leveraged to integrate data from traditional intelligence sensors and from non-traditional sources such as target acquisition systems to provide early-entry ground force commanders unprecedented battlefield awareness. User friendly intelligence and information warfare tools will provide quality data in a timely manner, and enable friendly commanders to operate inside of the enemy decision cycle. The objectives of these efforts are to gain information dominance, shape the battlefield and protect the force in accordance with concepts outlined for Force XXI intelligence operations.</p> <p>FY 1998 Accomplishments:</p> <ul style="list-style-type: none"> • 3318 – Developed laboratory exploitation techniques against wideband commercial communication signals used for military purposes. <ul style="list-style-type: none"> – Identified and developed command and control (C2) protect operational capabilities for deployed information systems and components. – Demonstrated laboratory exploitation capability against low power advanced communication system. – Developed breadboard of a field programmable gate array -based (FPGA) signal analysis/attack control system for potential IEWCS upgrade. • 3828 – Developed smart agent tools for effectively tasking and receiving multi-intelligence sensor data to support common ground station demonstration. <ul style="list-style-type: none"> – Developed advanced terrain reasoning tools, techniques, and signal intelligence (SIGINT) correlation, templating and associated terrain reasoning tools to enhance Common Ground Station (CGS) and All Source Analysis System (ASAS). – Established simulation project to assess incorporating information from airborne survivability equipment with conventional SIGINT assets. – Began prediction and assessment tools for electronic attack against modern communications signals. <p>Total 7146</p> <p>FY 1999 Planned Program:</p> <ul style="list-style-type: none"> • 3309 – Implement attack algorithms against modern communication and information systems, both military and commercial in a laboratory environment. <ul style="list-style-type: none"> – Demonstrate Electronic Support/Electronic Attack tactics techniques and procedures in controlled RF environment against a core signal set. 										
Project A906	Page 7 of 8 Pages					Exhibit R-2A (PE 0602270A)				

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602270A Electronic Warfare (EW) Technology	PROJECT A906
<p align="center">– Develop countermeasure analysis tools focusing on network protection.</p> <p>FY 1999 Planned Program (Continued):</p> <ul style="list-style-type: none"> • 3350 – Develop techniques to incorporate data from airborne survivability equipment and integrate into multi-sensor tasking and reporting tools. <ul style="list-style-type: none"> – Utilize COTS/GOTS software to enhance database storage and retrieval techniques. – Enhance SIGINT correlation, templating and associated terrain reasoning for visualization tools to enhance CGS and ASAS. – Develop tools to correlate intelligence data from tactical, other services and national assets to provide early entry ground force commander with multi-service data to increase survivability and lethality through enhanced battlefield awareness. • 104 – Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs <p>Total 6763</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 4019 – Modify existing testbed to emulate adversary digital communication networks, computer based networks and tactical information systems. Identify and assess the vulnerabilities and susceptibilities of RF and wired networked components. <ul style="list-style-type: none"> – Perform exploitation and attack strategies against the RF and wired network components in the enhanced testbed. • 3873 – Develop enhanced intelligence collection, asset management tools and terrain reasoning tools to provide effective, user-friendly intelligence data dissemination techniques and battle damage assessment tools to enhance and protect the commander's decision and execution cycle. <ul style="list-style-type: none"> – Enhance technologies to integrate, disseminate and display intelligence data from tactical and national assets necessary to provide/enhance situational awareness of red forces at the brigade level. – Investigate neural network tools to optimize sensor arrays for sensor cross-cueing to provide the capability to intercept emitters 90% of time, given the emitter is within sensitivity range of two distributed sensors. <p>Total 7892</p> <p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 4059 – Develop exploitation and attack capability against identified vulnerabilities and susceptibilities of adversaries' emerging communications networks and tactical information systems and computer based networks. <ul style="list-style-type: none"> – Develop methods, tactics, techniques and procedures to exploit emerging communication networks and tactical information systems and computer based networks with varying degrees of detectability to meet operational requirements. • 4099 – Develop software products to integrate existing joint and national intelligence sensors, provide a common format for integration of sensor information, and provide a common situational awareness of red forces for the brigade commander. <ul style="list-style-type: none"> – Develop neural network tools to optimize sensor cross-cueing to provide the capability to intercept emitters 90% of time, given the emitter is within sensitivity range of two distributed sensors UAV linkage. – Identify technologies and techniques to provide next generation tools for intelligence preparation of the battlefield, asset management, and situational awareness of red and blue forces. 		
Project A906	Page 8 of 8 Pages	Exhibit R-2A (PE 0602270A)

DATE
February 1999

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602270A Electronic Warfare (EW) Technology

Total 8158