

UNCLASSIFIED

<b>ARMY RDT&amp;E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)</b>	DATE <b>February 2000</b>
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BUDGET ACTIVITY <b>2 - Applied Research</b>	PE NUMBER AND TITLE <b>0602270A Electronic Warfare (EW) Technology</b>
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COST <i>(In Thousands)</i>	FY1999 Actual	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	15569	17402	17310	18378	18629	20241	21259	Continuing	Continuing
A442 Tactical Electronic Warfare Technology	9047	9547	9904	10095	10278	11315	11846	Continuing	Continuing
A906 Tactical Electronic Warfare Techniques	6522	7855	7406	8283	8351	8926	9413	Continuing	Continuing

**A. Mission Description and Justification:** This program investigates electronic warfare (EW) technologies that deny the enemy use of our Command, Control, Communications, Computer, and Intelligence (C4I) radio spectrum. This work covers the radio frequency (RF), infrared (IR), electro-optics (EO), and ultra-violet (UV) spectrum. Developments in electronic countermeasures (ECM) and self protection will protect Army forces from a broad range of RF surveillance/tracking systems, imaging radars, advanced RF/ EO/ IR missiles, and smart munitions. Automated intelligence fusion and automated battlefield assessment management tools are also being researched. These efforts will provide a decisive advantage to our operational forces against the full range of traditional and non-traditional threat forces. This will lead to winning the battlefield information war by controlling the electromagnetic spectrum and conducting successful electronic disruptive/destructive measures to threat mission planning. This program is primarily managed by Communications-Electronics Research, Development and Engineering Center (CERDEC), Fort Monmouth, NJ. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), 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 Advanced Technology), PE 0604270A (Electronic Warfare Development), and PE 0603745A (Tactical Electronic Support Systems - Advanced Development).

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<b>B. Program Change Summary:</b>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
Previous President's Budget ( <u>FY 2000/2001</u> PB)	16116	17487	18082
Appropriated Value	16249	17487	
Adjustments to Appropriated Value			
a. Congressional General Reductions	-133		
b. SBIR / STTR	-267		
c. Omnibus or Other Above Threshold Reductions		-46	
d. Below Threshold Reprogramming	-216		
e. Rescissions	-64	-39	
Adjustments to Budget Years Since ( <u>FY 2000/2001</u> PB)			-18
New Army Vision/Transformation Adjustment		TBD	-754
Current Budget Submit ( <u>FY 2001</u> PB)	15569	17402	17310

Change Summary Explanations: Funding – FY 2001: Projects were adjusted to reflect the new Army Vision/Transformation.

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BUDGET ACTIVITY <b>2 - Applied Research</b>			PE NUMBER AND TITLE <b>0602270A Electronic Warfare (EW) Technology</b>					PROJECT <b>A442</b>			
COST (In Thousands)			FY1999 Actual	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			9047	9547	9904	10095	10278	11315	11846	Continuing	Continuing
<p><b>Mission Description and Justification:</b> This project addresses the RF, IR, and EO technologies needed for self or stand-off protection of air and ground platforms and other high value assets. The following areas are investigated:</p> <ul style="list-style-type: none"> <li>- RF technologies that provide the capability to detect, identify, locate, prioritize, and countermeasure radar directed target acquisition, target-tracking sensors, surface-to-air, air-to-air, top attack and fused munitions.</li> <li>- IR technologies that provide the capability to detect, identify, locate, prioritize, and countermeasure heat seeking surface-to-air, air-to-air, and anti-tank guided munitions (ATGMs).</li> <li>- EO technologies that provide the capability to detect, identify, locate, prioritize, and countermeasure laser-aided and electro-optically directed gun or missile systems.</li> <li>- Electronic support (ES) technologies that provide the capability to intercept, direction find, and locate non-communications signals for targeting and tactical situational awareness.</li> </ul> <p><b>FY 1999 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3160 - Completed assessment of techniques for precision direction finding of ultra-high frequency (UHF) radars. <ul style="list-style-type: none"> <li>- Investigated the use of ultra-wideband digital RF memory for a potential use in RF countermeasures</li> <li>- Completed the design of IR and UV missile warning models for use in modeling and simulation of advanced electronic warfare suites.</li> </ul> </li> <li>• 2665 - Investigated short pulse laser effects against fielded advanced IR missiles for a potential improved IR countermeasure system. <ul style="list-style-type: none"> <li>- Conducted field measurements of IR and UV signatures of surface-to-air missiles (SAMs) and ATGMs, background and man made point false alarm sources.</li> </ul> </li> <li>• 960 - Completed testing of UV missile warning algorithms against air-to-air and ATGMs for aircraft protection. <ul style="list-style-type: none"> <li>- Investigated two color, mid IR missile warning algorithms for potential use in ground vehicle self protection</li> <li>- Investigated 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 hand-off capabilities.</li> </ul> </li> <li>• 2262 - Evolved and applied electronic intelligence (ELINT) cueing techniques to enable rapid detection and imaging of high priority targets, battle damage assessment, and threat avoidance over a wide area. <ul style="list-style-type: none"> <li>- Completed adaptive matched filter receiver to improve the capability of Common Modular ELINT System (CMES) to detect/characterize modern signals in the presence of a heavy conventional signal environment.</li> <li>- Performed laboratory demonstration of electronic support measures (ESM) capability against impulse radars using high impulse detector during international testing.</li> </ul> </li> </ul>											
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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE
BUDGET ACTIVITY		February 2000
<b>2 - Applied Research</b>	PE NUMBER AND TITLE	PROJECT
	<b>0602270A Electronic Warfare (EW) Technology</b>	<b>A442</b>
<b>FY 1999 Accomplishments: (continued)</b>		
	– Designed modular, full spectrum capable electronic counter measure and electronic counter-counter measure (ECM/ECCM) unmanned aerial vehicle (UAV) payload to react quickly to rapidly changing emitter Low probability of Intercept and Low Probability of Detection threats.	
Total	9047	
<b>FY 2000 Planned Program:</b>		
•	1308	– Investigate the use of evolving digital software radio receiver technology, to augment legacy radios 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 radar, communications signals, and measurement & signature intelligence (MASINT) sources for use in RF alerting and collection for tactical maneuver vehicle commanders. – Evolve Battle Lab scenario simulations to demonstrate warfighter benefit and develop operational concept for alerting and collection for tactical maneuver vehicle commanders.
•	976	– Evolve 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, with low probability of intercept, and frequency hopping air defense and surveillance radars. – Coordinate development of software with Naval and Air Force Research Lab (NRL and AFRL) for digital RF memory.
•	1880	– Enhance development of conformal and low observable, multi-octave antenna technology for upgrades to RF and missile warning systems. – Investigate low cost threat missile warning sensor technologies and algorithms for use in ground vehicle protection – Conduct survivability integration lab and field tests to refine next generation warning and countermeasures technologies and techniques. – Conduct field measurements of IR and UV signatures of surface-to-air missiles, ATGMs, background and man made point false alarm sources.
•	2867	– Investigate multi-band UV and IR countermeasure techniques to defeat emerging multispectral surface-to-air and air-to-air missiles. – Evolve IR countermeasures techniques to advanced anti-tank guided missile.
•	2343	– Address packaging, antenna, and signal processing technologies for the development of small, lightweight, remotely reconfigurable ES capability which employs sensor cross-cueing for precision geolocation of high value targets. – Evolve 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 waveform analysis for threat emitters and jamming techniques .
•	173	– Small Business Innovation Research / Small Business Technology Transfer Programs
Total	9547	
<b>FY 2001 Planned Program:</b>		
•	3507	– Enhance high-speed digital receiver that will provide the capability to receive, classify using specific emitter identification (SEI) and support 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.
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BUDGET ACTIVITY <b>2 - Applied Research</b>	PE NUMBER AND TITLE <b>0602270A Electronic Warfare (EW) Technology</b> PROJECT <b>A442</b>	
	<p><b>FY 2001 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Investigate 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.</li> <li>- Conduct field measurements of RF surface-to-air, air-to-air, and anti-aircraft artillery missiles systems and fuses for investigation into RF countermeasures techniques.</li> </ul>	
•	1964	- Complete investigation of low observable, multi-octave antenna technology, test and characterize sensitivity and observability parameters via hardware-in-the-loop simulation.
		- Continue design and development of low cost threat missile warning sensor technologies and algorithms for use in ground vehicle protection.
•	2969	- Conduct field measurements of IR and UV signatures of surface-to-air missiles, ATGM's, background and man made point false alarm sources.
		- Evolve and evaluate multi-band UV and IR countermeasure techniques to defeat emerging multispectral surface-to-air and air-to-air missiles.
•	1464	- Transition cooperative jamming and decoy/flare techniques to integrated countermeasures technology demonstration.
		- Evolve electrically reconfigurable antennas RF collectors for airborne and ground tactical maneuver vehicles.
		- Integrate spread spectrum receiver technology for eventual transition to countermeasure systems.
		- Perform research and development to provide ES technology to intercept, geolocate, and counter emerging hostile non-communications emitters on the battlefield.
		- Evolve algorithms for use on software radio programs, to demonstrate with Battle Labs for operational concept.
		- Evolve advanced antennas, micro electromechanical systems (MEMS) low voltage switch technology for collection and mapping
Total	9904	

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BUDGET ACTIVITY 2 - Applied Research			PE NUMBER AND TITLE 0602270A Electronic Warfare (EW) Technology					PROJECT A906			
COST (In Thousands)			FY1999 Actual	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			6522	7855	7406	8283	8351	8926	9413	Continuing	Continuing
<p><b>Mission Description and Justification:</b> The project researches key EW technologies to gain information dominance, shape the battlefield, and protect the force, in accordance with concepts outlined for Force XXI intelligence operations. Specifically, this program will research new ways to intercept, direction find, and locate current and emerging threat communications emitters. The results will be used for targeting, tactical situation awareness, and disruption/destruction of C4I systems. Specifically, this project develops integrated RF emitter collection and mapping technologies into multifunction devices, coupled with sensor feeds, to offer real time emitter detection, location, and identification. It also 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 C4I systems. In addition, this project 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. Other research areas include fusion (automated assimilation and synthesis) of battlefield intelligence data and brigade level joint intelligence, surveillance, and reconnaissance capability to address operational shortfalls. These last efforts provide critical technology underpinnings for friendly force ownership of the electromagnetic spectrum. Fusion and dissemination efforts will be used 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.</p> <p><b>FY 1999 Accomplishments</b></p> <ul style="list-style-type: none"> <li>• 2773 – Implemented attack algorithms against modern commercial communication and information systems, in a laboratory environment.             <ul style="list-style-type: none"> <li>– Completed ES/EA tactics techniques and procedures in controlled RF environment against a core signal set.</li> <li>– Adapted countermeasure analysis tools to focus on network protection.</li> </ul> </li> <li>• 3749 – Evolved techniques to incorporate data from airborne survivability equipment and integrate into multi-sensor tasking and reporting tools.             <ul style="list-style-type: none"> <li>– Utilized commercial/government off the shelf (COTS/GOTS) software to enhance database storage and retrieval techniques.</li> <li>– Enhanced Signal Intelligence (SIGINT) correlation, templating and associated terrain reasoning for visualization tools to enhance Common Ground Station (CGS) and All Source Analysis System (ASAS).</li> <li>– Evolved 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.</li> </ul> </li> </ul> <p>Total 6522</p> <p><b>FY 2000 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1959 – 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"> <li>– Perform exploitation and attack strategies against the RF and wired network components in the enhanced testbed.</li> </ul> </li> </ul>											
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<b>FY 2000 Planned Program: (continued)</b>		
<ul style="list-style-type: none"> <li>• 3810</li> <li>• 1959</li> <li>• 127</li> <li>Total</li> </ul>	<ul style="list-style-type: none"> <li>– Evolve 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.</li> <li>– 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.</li> <li>– 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.</li> <li>– Survey sources of data to be displayed and determine connectivity to national assets</li> <li>– Adapt developed Electronic Mapping object models to display information.</li> <li>– Evolve target set to identify priorities of targets.</li> <li>– Evolve SEI process.</li> <li>– Model concurrent collection/communication function with tactical internet.</li> <li>– Small Business Innovation Research / Small Business Technology Transfer Programs</li> </ul>	
<b>FY 2001 Planned Program:</b>		
<ul style="list-style-type: none"> <li>• 1800</li> <li>• 1800</li> <li>• 3806</li> <li>Total</li> </ul>	<ul style="list-style-type: none"> <li>– Generate exploitation and attack capability against identified vulnerabilities and susceptibilities of adversaries' emerging communications networks and tactical information systems and computer based networks.</li> <li>– Generate 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.</li> <li>– Evolve 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.</li> <li>– Evolve 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.</li> <li>– 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.</li> <li>– Integrate Electronic Mapping SIGINT Object Models into workstations.</li> <li>– Generate advanced algorithms using digital signal processing (DSP)-based optimization techniques and Artificial Intelligence (AI) sensor-cueing algorithms.</li> <li>– Generate advanced wavelet based algorithms for SEI.</li> <li>– Evolve signal, collection, mapping, analysis and visualization tools for auto-detection and templating, Battle Lab prototyping.</li> </ul>	
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