Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Office of Secretary Of Defense										DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*				R-1 ITEM NOMENCLATURE PE 0603662D8Z: *Networked Communications Capability*							
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**FY 2011 Base Estimate**	**FY 2011 OCO Estimate**	**FY 2011 Total Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	27.826	27.984	30.035	0.000	30.035	35.287	40.712	46.060	46.498	Continuing	Continuing
P662: *Airborne Network Gateway*	13.969	6.160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
P663: *Network Communications Analysis*	13.857	21.824	30.035	0.000	30.035	35.287	40.712	46.060	46.498	Continuing	Continuing

A. Mission Description and Budget Item Justification

Warfighters today rely more and more on communications networks to support and enable actions from targeting and shooting weapons to video-conferencing. Though military basic infrastructure capabilities follow the mainstream commercial internet, for many reasons (security, mobility, robustness), commercial telecommunications especially commercial wireless (tactical edge) communications are not well-matched with the requirements of today's warfighter. These trends will continue as the military data load becomes more diverse and heavy. The National Research Council's Network Science Report (2005) and Army Mobile Ad-hoc Network (MANET) Jason Report (January 2006) state that the type of networking projected to meet military tactical requirements are not supported by network theory, network design nor analysis tools. These tactical edge technology challenges cut across all warfare domains (space, air, ground, sea). In response to recognized technical problems today, as well as anticipated problems in the future, this research will focus on two key problems in networked technologies: the need for expanded wireless reach where no communications infrastructure exists, and the need to create ways to manage diverse wireless communications load and heterogeneous network types. Airborne Network Gateway will expand the wireless communications and networking reach for the tactical force in the form of an airborne network gateway capability. Network Communications Analysis will establish the scientific foundations for military tactical mobile networking with a specific emphasis on the integrated network management of tactical networks. This research will provide the technical basis to standardize the implementation of military network communications capabilities in the areas of airborne network gateways and network communications analysis across the military services, joint staff, OSD, and defense agencies.

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B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	39.923	28.212	0.000	0.000	0.000
Current President's Budget	27.826	27.984	30.035	0.000	30.035
Total Adjustments	-12.097	-0.228	30.035	0.000	30.035
• Congressional General Reductions		0.000			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds		0.000			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-1.475	0.000			
• SBIR/STTR Transfer	-0.458	0.000			
• Program Adjustments	-10.164	-0.228	30.035	0.000	30.035

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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
P662: *Airborne Network Gateway*	13.969	6.160	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

Airborne Tactical Relay - An airborne tactical relay capability enables Beyond Line of Sight (BLOS) range extension for tactical mobile communications. Within the current deployed forces there is no airborne network tier to support locally distributed ground and naval forces at lower tactical levels. The need to increase the capability to support tactical forces at lower levels is highlighted in the 2006 Naval Research Advisory Committee (NRAC) Distributed Operations Study. The current lack of an airborne tactical relay limits BLOS tactical communications to available satellite communications. This research will develop, integrate and demonstrate airborne tactical relay technology to support locally distributed tactical forces and achieve improved near-term networked communications capability. Focus will be placed on the transition from research to acquisition for accelerated fielding. Several candidate payloads and platforms will be investigated to meet the needs of the tactical military user at the lower tactical network tiers, for example, small unit relay. Upon the selection of candidates, the technologies will be integrated, matured and demonstrated to support transition. Research and development will include the development and integration of the payload to include Single Channel Ground and Airborne Radio System (SINCGARS), Enhanced Position Location and Reporting (EPLRS), and Soldier Radio Waveform (SRW) for example; the payload to platform integration to support demonstration; and the development of a small unit Concept of Operations (CONOPS) to demonstrate operations supported by the range extension for tactical units. Demonstrations will be used to support technology maturation and verify technology transition criteria.

Airborne Network Gateway - An airborne network gateway interconnects dissimilar networks among tactical forces and also interconnects tactical forces with higher headquarters and command centers. In general, gateways interconnect networks with different, incompatible communications protocols. Gateways are commonly used commercially in the wired internet world to bridge between different networks. The US Air Force has fielded the Battlefield Airborne Communications Node (BACN) and Rapid Attack Information Dissemination Execution Relay (RAIDER) in response to the need for high altitude airborne relay. This research program will leverage on-going projects, to develop and demonstrate a small tactical airborne gateway to support small units in distributed operations. The Airborne Network Gateway research will develop, integrate and demonstrate airborne network gateway technology to facilitate near term networked communications capability that will be transitioned to the field. Specifically, this research will investigate the data links (eg. Link-16, 1553), networks (eg. SRW, SINCGARS, EPLRS, HNW), and voice (eg. Cellular and UHF voice) candidates for an airborne network gateway, assess technology issues and maturity, and develop enhancements that will overcome shortfalls that preclude the ability to more broadly network the force through an airborne network gateway. One specific area of emphasis will be the analysis of the airborne network gateway effectiveness across sensor to weapon scenarios. Demonstrations will be used to support technology maturation and verify technology transition criteria.

Gateway Interoperability - Gateway functions on the ground and in the air are becoming common across the tactical battlefield to integrate disparate networks. Gateways as a general term include relays (range extension), bridges (connect across networks), message translation (connect across data links), and guards/cross

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domain security (connect across security domains). This research will define, develop, integrate, demonstrate, and assess technology that provides standards to perform gateway functions from the tactical edge to the core Global Information Grid (GIG) network. Many technologies and components exist to perform the variety of gateway functions discussed. These would be assessed to identify desirable aspects to be leveraged as the foundation for providing improved interoperability. Emphasis will be placed on demonstrating capabilities to support airborne tactical relays and airborne network gateways. The research will be expanded to provide the technical basis for standards and policies that can be applied across DoD, specifically in support of the GIG.

Airborne Network Gateway Open Call – A percentage of the Airborne Network Gateway funding will be dedicated to supporting new research initiatives in this technical area. Each fiscal year, a RFP will be sent out with specific technical focus area and evaluation criteria for each project. The proposals will be graded by a peer review team who score each proposal in each of predetermined criteria. Proposals are then selected based on total score.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Airborne Tactical Relay	6.289	3.465	0.000	0.000	0.000
Current program plan calls for the development and maturation of an airborne communications relay suitable for flight on a UAV. The relay will be demonstrated in an operational environment by the end of 2009 and transitioned in 2010. The first year's effort will be executed by the Marine Corps (Office of Naval Research) and the second year's effort will be executed by the Marine Corps (Office of Naval Research) and Army (Communications-Electronics Research, Development, and Engineering Center). Plans call for a common, joint airborne relay supporting tactical small units developed jointly by the Marine Corps and Army, to include development of the payloads and concepts of operation and transition directly to the Services. Research efforts include BTCR and Advanced Tactical Data Link. Overall goal: Increase the understanding of airborne tactical relays. Demonstrate the network communication technology required to support small unit distributed operations. Establish the concept of operations for how these technologies will be operationally used and supported. *FY 2009 Accomplishments:* BTCR: Procured (bought) platforms. Developed additional concepts of operation and conducted military utility assessment. Experimented with different payloads.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: FY2010 Accomplishments: Advanced Tactical Data Link: Navy initiated research effort to create models for advanced tactical network scenarios. FY2010 Plan BTCR: Continue the development for follow on assessment and technology maturation. Complete demonstration of operational relay capability. Transition to Marine, Army and CENTCOM partners. Incorporate integration of legacy waveforms in new platforms. Advanced Tactical Data Link: Bring in and incorporate models of existing systems and manipulate scenarios based on proposed Navy ConOps.					
Airborne Network Gateway *FY 2009 Accomplishments:* Improvement plan for Link 16 capability was terminated along with the related acquisition program.	4.095	0.000	0.000	0.000	0.000
Gateway Interoperability Current plan calls for initiation of this project in 2009 as a joint all service effort. Increase understanding of gateways, a complex area of networking within DoD. Establish the technical basis for DoD policy and standards for the Global Information Grid (GiG), specifically in the area of the tactical edge attachment to the GiG core networks. Research efforts include Enhanced Performance for HNW including Net Entry at Extended Range, GCIC Airborne Network Management Analysis, and Advanced Waveform Support.	3.585	1.188	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: Evaluated gateway technologies and program candidates. Defined the criteria for acceptable gateway technical and operational performance criteria. Enhanced Performance for HNW including Net Entry at Extended Range: Navy demonstrated initial gateway extended range capability at the C4ISR-OTM demonstration (in conjunction with the Army) and began to seek potential transition opportunities with in the Navy. Implemented concept to increase data rate and extend communications range. Advanced Waveform Support: Delivered reports on the evaluation and options for improvements to advanced airways forms. *FY 2010 Plans:* FY2010 Plan - Produce initial technical report for gateway standardization and interoperability. Build prototype gateway for Army and Marine Networks. Identify additional transition opportunities into programs of record. Enhanced Performance for HNW including Net Entry at Extended Range: Define interface spec for Type-1 extension to HNW. Advanced Waveform Support: Conduct research and create publications in the following areas: UHF waveforms, application coding, spectrum reuse, and antenna technology.					
Airborne Network Gateway Open Call A percentage of the Airborne Network Gateway funding will be dedicated to supporting new research initiatives in this technical area. Each fiscal year, a RFP will be sent out with specific technical focus area and evaluation criteria for each project. The proposals will be graded by a peer review team who score each proposal in each of predetermined criteria. Proposals are then selected based on total score.	0.000	1.507	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Overall goal: To add innovative research projects in the area of airborne networking to the program *FY 2010 Plans:* Distributed RFP. Create Peer Review Team. Evaluated and selected FY10 Proposals. Evaluate and select proposals and announce awards. Integrate new performers into the existing program.					
Accomplishments/Planned Programs Subtotals	13.969	6.160	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Strategic Goals Supported: Net-Centric Warfare/Joint Interoperable Communication

Existing Baseline: Prototype relays and gateways; initial federated, laboratory test beds; prototype joint network management tools

Planned Performance Improvement / Requirement Goal: Link expansion in prototype relays and gateways; continued integration in federated test beds; demonstration of prototypes and software tools

Actual Performance Improvement: Prototype and transition able relays and gateways; usage federated test beds; demonstration of prototypes and software tools

Planned Performance Metric / Methods of Measurement : Utilization of federated test beds; demonstration of prototypes and software tools

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Actual Performance Metric / Methods of Measurement : Progress on testbed development; prototype software demonstrated; prototype architectures developed

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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
P663: *Network Communications Analysis*	13.857	21.824	30.035	0.000	30.035	35.287	40.712	46.060	46.498	Continuing	Continuing

A. Mission Description and Budget Item Justification

Tactical Mobile Networking - As studies have suggested, for instance, the National Research Council's Network Science Report (2005) and Army Mobile Ad-hoc Network (MANET) Jason Report (January 2006), the type of networking projected to meet military tactical requirements are not supported by network theory, network design and analysis tools. This research will define those technical parameters important to military tactical mobile networking environments, investigate the status of network design and analysis tools, and evaluate how modeling and simulation is conducted to support tactical mobile networking environments. The role of network experimentation with respect to network modeling will be explored. Further development and analysis will be conducted to improve the awareness of the condition of tactical mobile networking technologies. Design tools, architectures and technical approaches will be recommended to acquisition programs as a result of this research.

Network Management Tools and Analysis - Network management in the commercial world is a highly organized, synchronized activity that has excellent tools to monitor activity and repair disrupted networks as needed. These same tools are ill-matched for management in the wireless world, and specifically for military tactical mobile networking. In addition, the military tactical mobile networking environment lacks the infrastructure (connectivity) and support (helpdesk) because resources (spectrum, people, equipment) are scarce (not in harms way). As the complexity of networking grows and as network capabilities are introduced, improved network management is required. For military operations, assured delivery may be needed for specific information and operations. This requires management tools to be in place to ensure continued secure and robust operations, which is not achieved with commercial wireless technologies. This research will assess network management tools in place for the military tactical mobile networking environment; develop technology and tools to address shortfalls with the goal to transition technology to operational systems.

Spectrum Management Tools and Analysis - For wireless, tactical mobile networking, the management of the use of spectrum effects network operations. The demand for spectrum is increasing due to the expanded use of sensors, imagery and voice. This demand increases the pressure on the limited shared radio frequency (RF) spectrum for military tactical networking. The current DoD frequency planning and management infrastructure will have a limited ability to cope with this demand through operational planning, Coalition Joint Spectrum Management Planning Tool (CJSMPT) Joint Capability Technology Demonstration (JCTD) and the Global Electromagnetic Spectrum Information System (GEMSIS). Advanced spectrum management concepts such as sense and adapt, spectrum sharing, and dynamic reallocation are under investigation but not yet mature support operations. This research will evaluate opportunities for more efficient and effective use of the frequency spectrum within DoD. Technology advances are expected to advance the concept of cognitive radio and cognitive antenna devices to sense and adapt operations based on spectrum policy and usage, the management of multi-band and multifunction apertures, and the use of spectrum efficient waveforms for use in military

environments. This research will develop the models and tools to demonstrate capabilities for operational planning and monitoring of spectrum as these technologies are introduced.

Integrated Network Management Capability - Network management becomes more complex as more and different types of networking capability become available. Integrated network management across heterogeneous systems, especially wireless systems, requires definition, design and development. Operationally, network management assumes all functions required to share networking resources and ensure proper operation for participants. This research will define integrated network operations tools for all aspects of network resource management and to prioritize across operational spectrum management, security management, network management, and information management. This research will also develop testbeds specially to validate models and simulations used to develop and test network management tools, and conduct experimentation on approaches developed.

Networked Communications Analysis Open Call – A percentage of the Networked Communications Analysis funding will be dedicated to supporting new research initiatives in this technical area. Each fiscal year, a RFP will be sent out with specific technical focus area and evaluation criteria for each project. The proposals will be graded by a peer review team who score each proposal in each of predetermined criteria. Proposals are then selected based on total score.

Tactical Networking Evolution and Expansion – Fielded and about-to-be-fielded tactical networks can be vastly expanded and evolved from their current capabilities by developing and applying new techniques (or existing techniques developed in basic research) to the existing systems, providing modern capability to the warfighter without the large expense to the DoD of developing new systems. This research will focus on developing and applying new DoD specific techniques to create leap-ahead approaches to Anti-Jam resistance of tactical networks, larger, more fully exploited networks, and expanded capabilities for signal/data processing and data compression in radios and across the networks. This research will take advantage of new software defined radios about to be fielded by the Department, as well as focus on the existing legacy systems, using the successful approach we developed when fielding the Netted Iridium capability.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Tactical Mobile Networking	3.229	4.356	4.510	0.000	4.510
This project is for the development of new applications and standards that can be used on existing tactical networks to improve data retrieval and discovery by the tactical warfighter. In addition, research is being conducted into tactical communications architectures to develop models useful for optimizing and exploiting tactical networks. New applications and architectures will be tested in a joint federated experimental emulation test bed being developed within this program. Project collaboratively executed					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
by the Navy and Air Force. Plan for transition to programs of record as maturity of models allow. Research efforts include Wireless Computational Networking Architecture, Heterogeneous Intelligent Filtering Extensions (HIF), Cooperative Heterogeneous Comms, Inter-domain Routing, and Tactical Edge Group Wise Networking. Overall goal: Increase understanding of the condition of tactical mobile networking technologies. Improve specification of technical standards and policy for tactical mobile networking. Finer fidelity modeling and simulation to support operations analysis and the articulation of operational requirements and performance parameters. *FY 2009 Accomplishments:* Began research in cognitive networking (architecture and antenna related work). Continued the development of an improved set of tools. Developed testbeds (VAN, eMANE) and began demonstrating tools in a laboratory testbed environment. Wireless Computational Networking Architecture: Conducted WCNA unmanned aerial vehicle tests at the AFRL outdoor testbed. Developed new wireless transport and routing protocols. HIF: Conducted a demonstration of initial HIF capabilities for NRL. Integrated HIF components with JTRS HMS radio platforms and upper echelon surrogate platforms for C4ISR-OTM demonstration. Tactical Edge Group Wise Networking: Navy deployed experimental infrastructure and worked with the Army to implement and extended a tactical edge scenarios in the Army's TITAN tool. *FY 2010 Plans:* Wireless Computational Networking Architecture: Using transport protocols to develop a software infrastructure that supports application development. Develop spectral clustering method. HIF: Begin development of more detailed filtering capabilities. Inter-domain Routing: Define study scenario and approaches. Tactical Edge Group Wise Networking: Initiate development of CORE group-oriented networking protocols.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Continue work in cognitive networking. Demonstrate architectures and tools in testbeds and operational evaluations. Explore areas for cross-service collaboration. Explore potential transition opportunities for tools. Begin work on an advanced tactical network scenario modeling and simulation environment. HIF: Begin test in conjunction with Army JINX effort to filter network management traffic. Create a policy management interface for HIF tool. Develop multiple HIF gateways. Integrate HIF into the Army VAN testbed. Inter-domain Routing: Obtain study results using Lincoln Labs emulation testbed. Extend research into other network communications capability testbeds (Navy eMANE, Army VAN testbed) Wireless Computational Networking Architecture: Explore TCP routing and AHFS using the developed spectral clustering method. Perform additional indoor and outdoor field tests. Tactical Edge Group Wise Networking: Create advance metrics and analytics to study dynamic group structures. Continue to investigate DTN as it relates to supporting group and distributed operational use. Create and transition emulation scenarios to be used in evaluations. Cooperative Heterogeneous Comms: Work to improve network communications protocol. Simulate more general and dynamic topologies. Conduct research using the MIT Lincoln Lab emulation facilities. *FY 2011 Base Plans:* Begin development of early prototypes for field testing. Identify transition opportunities.					
Network Management Tools and Analysis This project is for the development of joint standards and tools for policy-based and measurement-based tactical network management. New standards and applications will be tested in a joint federated experimental emulation test bed being developed within this program. Project jointly executed by the Navy, Air Force and Army, with technology transition agreements being pursued with programs of record. Research efforts include Network Agent Technology for Management (NATM), Joint	3.670	5.209	5.709	0.000	5.709

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Integrated Network Management System Exchange (JINX), Small Form Factor Cross Domain Solution (SFF CDS), Cyber Security Metrics Trust Model, Explicit Congestion Network (ECN) Message Based Admission Control (MBAC), Tactical Resource Management and Control, NEEMO, and High Performance Information Assurance for Wireless Applications. Goals: Increase understanding of the complexity of the tactical network management. Determination of the support required for tactical network operations. Evaluation of technology to support transition and fielding to operational capability. Overall goal: Increase understanding of the complexity of tactical network management. Determination of the support required for tactical network operations. Evaluation of technology to support transition and fielding to operational capability. *FY 2009 Accomplishments:* Developed tools to address joint network management interoperability across network management systems and conducted required capability demonstrations. Continued to refine both policy-based and measurement based network management tools. Initiated technology transition planning. Began validation of developed tools in testbed facilities. NATM: Developed inter-network management system messaging adaptive middleware system security and enhanced data within Army DRAMA tool. Demonstrated capabilities at Networks program review. JINX: Designed and built prototype for JINX Small Form Factor Cross Domain Solution: Completed market survey of SFF CDS. ECN MBAC: Completed Phase 1 prototype NEEMO: Navy identified and transitioned tool to Deep Lightning Bolt and CABLE. High Performance Information Assurance for Wireless Applications: Prototyped crypto module and host board. Tested prototype with various algorithm crypto applications.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: Further develop and demonstrate management tools to evaluate technical maturity and military utility. Transition tools to existing programs; Initiate selection and evaluation of next generation Network Management tool set. NATM: Extend NATM framework beyond the domain of network performance to address network security. Adjust the NATM framework to ensure information adaptability to varying distribution requirements, mission situations, and management information. JINX: Produce final whitepaper. Small Form Factor Cross Domain Solution: Create a remote management/situational awareness architecture. Cyber Security Metrics Trust Model: Create security metrics assessment tool. Create computer network defense and attack models. ECN MBAC: Plan to submit whitepaper to MILCOM 2010. Conduct test in the Army network-in-the-loop testbed. Create an ECN MBAC Phase 2 report and software library. Coordinate efforts with ARL. Tactical Resource Management and Control: Create design for emulating research management and conduct test in Lincoln Labs emulation testbed. Produce final report on test results. NEEMO: Add features to support NEEMO to include automatic correlation of flow records from multiple sources, on-way delay measurements, export of alerts and alarms to other management systems, develop control channel for remote filtering/control options, integrating NORM delivery service, and time synchronization. Work to compress overhead. High Performance Information Assurance for Wireless Applications: E-model tactical edge crypto device based on PEIP. Finalized COMSEC red and black interfaces needed for tactical systems. Demonstrate capabilities. *FY 2011 Base Plans:* Incorporate additional NetOps/Situational Awareness components by specifically integrating security management and IA.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Spectrum Management Tools and Analysis	2.498	3.185	3.190	0.000	3.190

This project is for the development of measurement-based spectrum management tools. Applications will be developed and tested in a laboratory environment. Project executed by the Army with results available to the Navy and Air Force through the Joint NETOPS Integrated Collaborative Working Group. Transition planned for the GEMSIS program in 2010-2011 as maturity allows, and to other existing tactical network programs as appropriate. Research efforts include CERDEC Spectrum Management, Cognitive Networking Radio Platform, SIGINT-assisted Spectrum Management, Cognitive Radio Architecture Research, and Networking for Spectrum Aware Cognitive Radios.

Overall goal: Develop the technical basis to support changes regarding the operational use of spectrum both within the military and among spectrum regulatory bodies.

FY 2009 Accomplishments:

Began development of a functional cognitive radio architecture and interfaces specification. Completed demonstrations of a baseline cognitive radio framework. Began work on spectrum sensing interfaces for cognitive radios. Initiated collaborative cognitive radio research among the Services (Army and Navy). Began investigation of transition areas. Completed and submitted research publications.

CERDEC Spectrum Management: Standardized dynamic spectrum access (DSA) policy language capability. Created a realistic electromagnetic environment (EME) specification. Completed first release of DSA policy generation tool.

Cognitive Networking Radio Platform: Developed a functional cognitive radio architecture and interfaces specification. Identified software and hardware interfaces for the cognitive radio architecture. Developed and implemented base-line JTRS SCA cognitive radio framework.

SIGINT-assisted Spectrum Management: Created spectrum management architecture description.

Cognitive Radio Architecture Research: Surveyed industry, DoD, and academia to create report on existing cognitive radio technology. Conducted cognitive research GNU radio and Matlab.

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Networking for Spectrum Aware Cognitive Radios: Studied spectrum-based minimum length scheduling. Published finding on frequency utilization in wireless networks. Published findings on interference modeling research ACM MobiHOC 2009.					
FY 2010 Plans: Demonstrate and transition technologies for spectrum management. Initiate identification and evaluation of next generation Spectrum Management tool set. CERDEC Spectrum Management: Creating a software library for DSA policy generation. Generating propagation models for DSA policy software analysis. Creating a DSA policy dissemination mechanism. Creating an electronic warfare DSA coexistence policy report. Cognitive Networking Radio Platform: Expand cognitive radio framework specifications to include cognitive networking specifications that allow the insertion of current and future algorithms and models from Joint Services. SIGINT-assisted Spectrum Management: Use SIGNT data to track interference emitter location and frequencies to allow the capability to mitigate interference and outages. Create better SIGNT modeling data. Create better models for spectrum management. Explore alternative concepts (distributive spectrum sensing and alternate SIGNT modalities). Cognitive Radio Architecture Research: Created standard environmental profile and/or models. Collaborate, document, and share test results with CERDEC through integration with CERDEC's emulation testbed. Networking for Spectrum Aware Cognitive Radios: Develop algorithms that improve node cooperation via the use of relay nodes. Study the impact of heterogeneity in the available spectrum at different locations of the network. Explore collaboration with Virginia Tech on studying capacity scaling laws for cognitive radio networks.					
FY 2011 Base Plans: Integrate next generation Spectrum Management tool set in existing operational environments (ie. Spectrum management centers).					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Office of Secretary Of Defense		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603662D8Z: *Networked Communications Capability*	PROJECT P663: *Network Communications Analysis*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Integrated Network Management Capability	3.580	7.568	7.821	0.000	7.821

This project is for the development of joint integrated network management tools, and three federated experimental test beds for the development and evaluation of integrated tactical network management and spectrum management. Project executed jointly by the Navy, Army and Air Force. Plans also establish a Joint Network Operations (NETOPS) Integrated Collaborative Working Group for the establishments of standards and joint development in support of all projects in this program. Membership includes the research community from the Navy, Marine Corps, Army and Air Force as well as developers from acquisition programs such as Future Combat Systems (FCS), Warfighter Information Network-Tactical (WIN-T) and Joint Tactical Radio System (JTRS). Future plans call for further joint infrastructure test bed development to include DoD PlanetLab as well as joint networking tools in support of NETOPS. The results of this research will transition to future increments of JTRS and WINT, and if successful, to the field through a joint integrated tactical NETOPS program. Research efforts include Joint Network Management Interoperability, Wireless Networking Library (WNL), Network Emulation and Experimentation, and Tactical Edge Wireless Experimentation.

Overall goal: Common integrating framework to support interoperability among various aspects of developmental network operations and management to include: spectrum management, network management, security management and information management. Reduce the cost to develop, procure and support networks through the integration across networks and functions within networks.

FY 2009 Accomplishments:
Completed initial Spiral development on joint federated test beds (between Army and Navy). Continued to define an integrated network management framework. Demonstrated tools that provide integrated network management (Navy eMANE and NEEMO; Army NITL and SITL; AF NATM). Joint Network Management Interoperability: Completed Spiral One of the virtual ad hoc network testbed (VAN). Completed Spiral Two of the Network-in-the-Loop (NITL) testbed adding dynamic routing mobility. Completed a policy analysis detection trade study. Completed a policy meta language study.

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Wireless Networking Library: Began to populate datasets in the network management data library and obtained an initial user set for the tool. Network Emulation and Experimentation: Improved network emulation environment. Conducted a joint experiment with AFRL. Supported external programs including IRIS, JTRS, and WIN-T. Tactical Edge Wireless Experimentation: Conducted mobile networking modeling workshop. Continued eMANE development. Created max-eMANE facility which includes 200 plus hardware nodes of emulation capability and demonstration and presentation space. *FY 2010 Plans:* Joint Network Management Interoperability: Integrate Army VAN testbed with the Navy's eMANE by creating an eMANE to VAN adaptor. Wireless Networking Library: Work to increase participation (submission and usage) of network management data library. Create advertising article for WNL and conduct additional advertising events. Create WNL usage and summary report. Network Emulation and Experimentation: Create interconnected emulation capability with CERDEC and NRL and conduct a joint experiment with each. Tactical Edge Wireless Experimentation: Integrate Army VAN testbed with the Navy's eMANE by creating an eMANE to VAN adaptor. Create eMANE developer training. Conduct additional mobile networking workshop. Add high performance optimizations to eMANE. Create detection and jamming models. Transition test beds to Services. Initiate DoD PlanetLab test and development facility. Demonstrate tools in an operational environment, transition tool set. Perform a joint Service lab inter-connection specifically using a "chat" capability to validate experimentation. Initiate selection and evaluation of next generation integrated network management software tools.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: Integrate next generation integrated network management software tools in existing operational environments (ie. TNOCs, JTF-GNO).					
Networked Communications Analysis Open Call A percentage of the Networked Communications Analysis funding will be dedicated to supporting new research initiatives in this technical area. Each fiscal year, a RFP will be sent out with specific technical focus area and evaluation criteria for each project. The proposals will be graded by a peer review team who score each proposal in each of predetermined criteria. Proposals are then selected based on total score. Overall goal: To add innovative research projects, in the area of networked communications, to the program *FY 2010 Plans:* Distributed RFP. Create Peer Review Team. Evaluated and selected FY10 Proposals. Evaluate and select proposals and announce proposal awards. Integrate new performers into the existing program. *FY 2011 Base Plans:* Create and distribute FY11 RFP. Conduct a Peer Review Conference where proposal candidates will present their work to the Peer Review teams.	0.000	1.506	4.000	0.000	4.000
Tactical Networking Evolution and Expansion This project is for the development of new applications and approaches that can be used on existing tactical networks to improve the physical- and networking layers for the tactical warfighter. It will	0.000	0.000	4.805	0.000	4.805

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
explore new ways to build architectures, antennas, signal and data processing or exploit waveforms to improve Anti-Jam resistance, network throughput and scale, or network packet routing to improve these metrics, at low cost and without sacrificing interoperability. Overall goal: Next generation tactical networking in the fielded tactical systems, with vastly increased capabilities, at the lowest cost possible to the DoD. *FY 2011 Base Plans:* Begin development of early prototypes for Anti-Jam improvements field testing. Identify transition opportunities. Goal is to demonstrate capabilities in FY2012. Begin planning for additional improvements to increase throughput, scale and IP-networking capability. Identify other candidate improvements. Evaluate operational impact of potential improvements.					
Netted Iridium DTCS - JUON Deliver an Over-the Horizon (OTH), on-the-move, Beyond-Line-of-Sight (BLOS) communications and network management capability to disadvantaged users operating in overseas combat areas. Productize the experimental Netted Iridium (NI) radio capability in order to provide OTH and BLOS to the CENTCOM Area of Responsibility (AOR). *FY 2009 Accomplishments:* Completed production ready prototypes, network gateway, satellite upgrades, training and sustainment packages. Delivered network of approximately 50 radios, and delivered training to field. Initiated transition to Army for production of additional radios, as required. *FY 2010 Plans:* Upgrade satellite software and network management gateway software (moving from a SVSB to an SVMB architecture) to double network range and increase number of networks by a factor of 5. Integrate higher level security classification (NSA Type 1) in the radios.	0.880	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Accomplishments/Planned Programs Subtotals	13.857	21.824	30.035	0.000	30.035

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

The Netted Iridium (NI) capability will be transitioned directly to production and sustainment to the DTCS-Army program by the Army for use in the CENTCOM AOR. Other program capabilities will be transitioned to acquisition programs as successful and appropriate.

E. Performance Metrics

Strategic Goals Supported: Net-Centric Warfare/Joint Interoperable Communication. Meet current needs of tactical warfighter

Existing Baseline: Prototype relays and gateways; initial federated, laboratory test beds; prototype joint network management tools

Planned Performance Improvement / Requirement Goal: Link expansion in prototype relays and gateways; Continued integration in federated test beds; demonstration of prototypes and software tools

Actual Performance Improvement: Prototype and transition able relays and gateways; Usage federated test beds; demonstration of prototypes and software tools

Planned Performance Metric / Methods of Measurement: Utilization of federated test beds; demonstration of prototypes and software tools

Actual Performance Metric / Methods of Measurement: Progress on test bed development; prototype software demonstrated; prototype architectures developed