

OSD RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2008

APPROPRIATION/ BUDGET ACTIVITY
RDTE, Defense Wide BA 03

PE NUMBER AND TITLE
0603662D8Z - Networked Communications Capability

COST (\$ in Millions)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
Total Program Element (PE) Cost		14.871	39.923	28.727	26.302	26.697	27.266
P662 Airborne Network Gateway		7.435	19.962	8.915			
P663 Network Communications Analysis		7.436	19.961	19.812	26.302	26.697	27.266

A. Mission Description and Budget Item Justification: (U) War-fighters today rely more and more on communications networks to support and enable actions from targeting and shooting weapons to video-conferencing back home. 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 war-fighter. These trends will continue as the military data load becomes more diverse and heavy. The National Research Councils 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.

<u>B. Program Change Summary</u>	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2008)		40.000	40.000
Current BES/President's Budget (FY 2009)		14.871	39.923
Total Adjustments		-25.129	-0.077
Congressional Program Reductions		-25.129	
Congressional Rescissions			
Congressional Increases			
Reprogrammings			
SBIR/STTR Transfer			
Other			-0.077

OSD RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2008

APPROPRIATION/ BUDGET ACTIVITY
RDTE, Defense Wide BA 03

PE NUMBER AND TITLE
0603662D8Z - Networked Communications Capability

C. Other Program Funding Summary Not applicable for this item.

D. Acquisition Strategy Not applicable for this item.

E. Performance Metrics:

FY	Strategic Goals Supported	Existing Baseline	Planned Performance Improvement / Requirement Goal	Actual Performance Improvement	Planned Performance Metric / Methods of Measurement	Actual Performance Metric / Methods of Measurement
08	Net-Centric Warfare/Joint Interoperable Communicat	Experimental relays and gateways; Non-federated, modest laboratory test beds; no joint network man	Prototype relays and gateways; Completion of init	TBD (new start)	Completion of initial federated test beds; demonstr	TBD (new start)

Comment: Network Communications Analysis comprises multiple research efforts which are just under development as of this writing. Metrics for success for the overall effort will be in the modes of infrastructure development and knowledge generation, and be measured according to the quality and relevance to the topic. Metrics for individual research initiatives will vary according to the mode, but will include performance, quality, relevance and the generation of human capital at a minimum. Lastly, technology selection and transition will be assessed according to success or failure for each of the sub-project areas.

OSD RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2008

APPROPRIATION/ BUDGET ACTIVITY RDTE, Defense Wide BA 03		PE NUMBER AND TITLE 0603662D8Z - Networked Communications Capability					PROJECT P662	
COST (\$ in Millions)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	
P662 Airborne Network Gateway		7.435	19.962	8.915				

A. Mission Description and Budget Item Justification: Airborne Tactical Relay - (U) 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 - (U) 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 Department of Defense (US Air Force) has initiated a program, Objective Gateway, to develop a family of modular, scalable airborne and ground-based gateways based on the reduction/demonstration efforts, Battlefield Airborne Communications Node (BACN) and Rapid Attack Information Dissemination Execution Relay (RAIDER). As an airborne network gateway, the Objective Gateway program will bridge between disparate data links and voice networks, integrate sensors into the network and provide Internet Protocol (IP) connectivity to the tactical edge. 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 Objective Gateway program. Specifically, this research will investigate the data links (eg. Link-16), networks (eg. Tactical Targeting Network Technology (TTNT)), and voice (eg. cellular) 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 - (U) As discussed above, the Objective Gateway program will develop a family of modular, scalable airborne and ground-based gateways. Additionally, there will be gateway functions performed by other components within the network. Gateways as a general term include relays (range extension), bridges (connect across networks), message translation (connect across data links), and guards/cross 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 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 Global Information Grid.

OSD RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2008

APPROPRIATION/ BUDGET ACTIVITY
RDTE, Defense Wide BA 03

PE NUMBER AND TITLE
0603662D8Z - Networked Communications Capability

PROJECT
P662

B. Accomplishments/Planned Program:

Accomplishments/Planned Program Title:

FY 2007

FY 2008

FY 2009

Airborne Tactical Relay

4.159

9.780

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. I

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 2008 Plan/Accomplishments (U) Platforms selected; payload selection under way. Plans call for the development, integration and test of the payloads; procure (lease) platforms (UAV, ground terminals and portable equipment); and initiation of payload to platform integration for operational demonstration. Establish the concept of operations and operational scenario to be evaluated at the military utility assessment. Initiate technology transition criteria.

FY 2009 Plan (U) Procure (buy) platforms; Complete integration for operational demonstrations. Develop concepts of operation and conduct military utility assessment. Assess technology maturity and validate technology transition criteria. Continue the development for follow on assessment and technology maturation.

Accomplishments/Planned Program Title:

FY 2007

FY 2008

FY 2009

Airborne Network Gateway

3.181

4.890

Current program plan calls for the development and demonstration of Concurrent Multinetting to enhance Link 16 and enable multiple networks to operate concurrently and interoperate on a single platform. In addition, other enhancements will be evaluated for enhancing Link 16 and enabling interoperation between IP-type networks and Link 16. These enhancements will be developed during 2008-2010 by the Navy (SPAWAR Systems Center) in collaboration with the Air Force (Langley), with a target transition to the Navy (MIDS-LVT and JTIDs program offices) and Air Force (Langley) in 2011. These enhancements will be offered to international partners to enable interoperation with joint and coalition communications networks. Current plan also calls for the development of further enhanced gateway capability with additional tactical networks in 2009 to be executed by the Navy, Air Force and Army to develop and build the technologies necessary for a joint gateway that will interconnect diverse tactical networks.

Overall goal: Evaluation of the technology maturity of the data link, networks, and voice capabilities to be integrated into a form factor with size, weight, and power design constraints. Development of enhancements to improve networking across the battlespace. Incorporation of standards that will lead to improved interoperability. Increased understanding of the operational concepts that will use this integrated capability.

FY 2008 Plan/Accomplishments - (U) Link 16 gateway enhancements to be evaluated selected. Evaluation under way. Plans call for the assessment of technology maturity of data link, network and voice communications capability to be used for airborne network gateway candidates. Initiate the development of enhancements to support shortfalls discovered. Initiate the development of technology transition criteria.

OSD RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)	February 2008
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APPROPRIATION/ BUDGET ACTIVITY RDTE, Defense Wide BA 03	PE NUMBER AND TITLE 0603662D8Z - Networked Communications Capability	PROJECT P662
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FY 2009 Plan - (U) Conduct operational demonstration of enhancements developed for the airborne network gateway capability. Select new candidates for gateway development and integration. Initiate research to support airborne gateway for specific existing tactical communications networks. Assess technology maturity of candidates. Conduct military utility assessment. Continue development for follow on assessment and technology maturation.

<u>Accomplishments/Planned Program Title:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Gateway Interoperability			4.852

Current plan calls for initiation of this project in 2009 as a joint Navy-Marine Corps-Army-Air Force 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, specifically in the area of the tactical edge attachment to the Global Information Grid core networks.

FY 2008 Plan - (U). N/A _ Initiation in 2009.

FY 2009 Plan - (U) Evaluate gateway technologies and program candidates. Define the criteria for acceptable gateway technical and operational performance criteria. Initiate the integration of gateway candidates for testing and assessment. Produce initial technical report for gateway standardization and interoperability. Initiate the development of technology to fill shortfalls for airborne tactical relay and airborne network gateway. Complete gateway testing and assessment.

<u>Accomplishments/Planned Program Title:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Administration and Studies		0.095	0.440

Funding retained at OSD annually for contractual and SETA/Studies support

C. Other Program Funding Summary Not applicable for this item.

D. Acquisition Strategy Not applicable for this item.

E. Major Performers

Category	Name	Location	Type of Work and Description	Award Date
<u>Labs/Centers</u>				
	SPAWAR Systems Center	San Diego, CA	Conduct research and engineering for Link 16 improvements and gateway capability; Expected January 2008	

OSD RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2008

APPROPRIATION/ BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT
RDTE, Defense Wide BA 03		0603662D8Z - Networked Communications Capability		P662
	Office of Naval Research	Arlington, VA	Administers (unpaid) and awards contracts to commercial research and development organizations to develop and deliver airborne network relay and gateway capability. Expected January 2008 (to ONR); Expected February 2008 (to contractor)	
<u>Universities</u>				
	MIT/Lincoln Labs	Lexington, MA	Host data warehouse for program data and research paper products from project 662 and 663; Expected January 2008	

OSD RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2008

APPROPRIATION/ BUDGET ACTIVITY RDTE, Defense Wide BA 03		PE NUMBER AND TITLE 0603662D8Z - Networked Communications Capability					PROJECT P663	
COST (\$ in Millions)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	
P663 Network Communications Analysis		7.436	19.961	19.812	26.302	26.697	27.266	

A. Mission Description and Budget Item Justification: Tactical Mobile Networking (U) As studies have suggested, for instance, the National Research Councils 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 - (U) 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, and 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 - (U) 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 (CJSMP) Joint Capability Technology Demonstration (JCTD) and the Global Electromagnetic Spectrum Information System (GEMISIS). 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 devices to sense and adapt operations based on spectrum policy and usage, the management of multiband 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 - (U) Network management becomes more complex as more and different types of networking capability becomes 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

OSD RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2008

APPROPRIATION/ BUDGET ACTIVITY
RDTE, Defense Wide BA 03

PE NUMBER AND TITLE
0603662D8Z - Networked Communications Capability

PROJECT
P663

approaches developed.

B. Accomplishments/Planned Program:

Accomplishments/Planned Program Title:

FY 2007

FY 2008

FY 2009

Tactical Mobile Networking

0.761

4.851

Current plan calls 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 by the Navy and Air Force. Results planned for transition to programs of record as maturity of models allow.

Overall goal: Increased understanding of the condition of tactical mobile networking technologies. Improved 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 2008 Plan/Accomplishments (U) Work under way presently executed by the Navy and Air Force. Define the technical parameters to be met for tactical mobile networking. Evaluate modeling and simulation along with design and analysis tools to support tactical mobile networking. Initiate the development of an improved set of tools to support tactical mobile networking. Initiate experimentation to evaluate tools

FY 2009 Plan (U) Initiative research into other areas applicable to the joint tactical environment such as cognitive networking. Continue the development of an improved set of tools. Develop testbeds and demonstrate tools in a laboratory testbed environment.

Accomplishments/Planned Program Title:

FY 2007

FY 2008

FY 2009

Network Management Tools and Analysis

1.666

5.291

Current plan calls 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.

Overall goal: Increased 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.

FY 2008 Plan/Accomplishments (U) Initial policy-based Network Management tools selected jointly by the Air Force and Army and evaluation underway. Measurement-based tactical network management tools under development by the Navy. Plans to share results and tools in a collaborative environment (called the Joint NETOPS Integrated Collaborative Working Group) established. Plan for this year calls for the assessment of network management tools for the military tactical mobile networking environment in operational and laboratory testbed environments. Develop technology and tools to address shortfalls.

FY 2009 Plan (U) Further develop and demonstrate management tools to evaluate technical maturity and military utility. Initiate technology transition planning.

OSD RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)		February 2008		
APPROPRIATION/ BUDGET ACTIVITY RDTE, Defense Wide BA 03	PE NUMBER AND TITLE 0603662D8Z - Networked Communications Capability		PROJECT P663	
<u>Accomplishments/Planned Program Title:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
Spectrum Management Tools and Analysis		0.543	3.780	
<p>Current plan calls 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.</p> <p>Overall goal: Technical basis to support changes regarding the operational use of spectrum both within the military and among spectrum regulatory bodies.</p> <p>FY 2008 Plan/Accomplishments (U) Work underway. Develop the spectrum technology strategy for the introduction of advanced capability beyond operational mission planning. Demonstrate technologies to support monitoring and plan adjustments as spectrum conditions allow. Assess emerging spectrum technologies for inclusion to support military operations.</p> <p>FY 2009 Plan (U) Expand program into spectrum-aware, cognitive networking for existing tactical networks. Demonstrate concepts and technologies to support a more efficient and effective use of spectrum. Initiate collaborative research among the Services.</p>				
<u>Accomplishments/Planned Program Title:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
Integrated Network Management Capability		4.231	5.159	
<p>Current plan calls 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 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 FCS, WIN-T and 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.</p> <p>Overall goal: Common integrating framework to support interoperability among various aspect 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.</p> <p>FY 2008 Plan/Accomplishments (U) Work underway. Working Group established. Establish federated testbeds at Army, Navy and Air Force research facilities to explore how individual network management tools work together in diverse tactical networks. Establish the integrating framework for network management. Demonstrate network managers to assess technical shortfalls. Initiate development of integrated management tools.</p> <p>FY 2009 Plan (U) Complete joint federated test beds and transition test beds to Services, initiate DoD PlanetLab test and development facility. Continue the definition of an integrated network management framework. Demonstrate tools that provide integrated network management.</p>				

OSD RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2008

APPROPRIATION/ BUDGET ACTIVITY RDTE, Defense Wide BA 03	PE NUMBER AND TITLE 0603662D8Z - Networked Communications Capability	PROJECT P663	
<u>Accomplishments/Planned Program Title:</u>		<u>FY 2007</u>	<u>FY 2008</u>
Administration and Studies			0.235
			0.880

Funding retained at OSD annually for contractual and SETA/Studies support.

C. Other Program Funding Summary Not applicable for this item.

D. Acquisition Strategy Not applicable for this item.

E. Major Performers

Category	Name	Location	Type of Work and Description	Award Date
<u>Labs/Centers</u>				
	Electronic Systems Center	Hanscom AFB, MA	Research into Network Management; Serves as government technical POC for AF wireless testbed; Expected January 2008	
	Air Force Research Labs/Rome Labs	Rome, NY	Research into tactical mobile wireless networking; Expected January 2008	
	Communications-Electronics Research, Development,	Ft. Monmouth, NJ	Lead agent for federation of government wireless testbeds; build and host Army wireless test bed; conduct research in network management and spectrum management; Expected January 2008	
	Naval Research Laboratory	Washington, DC	Build and host Navy wireless test bed; conduct research into network management and mobile wireless networking; Expected January 2008	
<u>Universities</u>				
	MIT/Lincoln Labs	Lexington, MA	Build and host Air Force wireless testbed; conduct research into network management; Host data warehouse for program data and research paper products for projects 662 and 663; Expected January 2008	