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Exhibit R-2, PB 2010 Office of Secretary Of Defense RDT&E Budget Item Justification **DATE:** May 2009

APPROPRIATION/BUDGET ACTIVITY					R-1 ITEM NOMENCLATURE					
0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)					PE 0603662D8Z Networked Communications Capability					
COST (\$ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	29.068	29.759	28.212						Continuing	Continuing
P662: Airborne Network Gateway	3.101	14.880	8.756						Continuing	Continuing
P663: Network Communications Analysis	25.967	14.879	19.456						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) JASONS Report (January 2006) state that the type of networking projected to meet military tactical requirements is 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)

	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>
Previous President's Budget	14.871	39.923	28.727	
Current BES/President's Budget	29.068	29.759	28.212	
Total Adjustments	14.197	-10.164	-0.515	
Congressional Program Reductions		-10.000		
Congressional Rescissions		-0.164		
Total Congressional Increases				
Total Reprogrammings	14.426			
SBIR/STTR Transfer	-0.229			
Other			-0.515	

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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 NUMBER P662	
COST (\$ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
P662: Airborne Network Gateway	3.101	14.880	8.756						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 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, 1553), 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.

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<p>Gateway Interoperability - 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 technologies that provide standards to perform gateway functions from the tactical edge to the core Global Information Grid network (GIG). 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.</p>					
B. Accomplishments/Planned Program (\$ in Millions)		FY 2008	FY 2009	FY 2010	FY 2011
<p>Airborne Network Gateway</p> <p>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 interoperability between IP-type networks and Link-16. These enhancements will be developed during CY 2008-2010 by the Navy (SPAWAR Systems Center) in collaboration with the Air Force (Langley), with a target transition to the Navy Joint Tactical Information Distribution System (JTIDS) and the Multi-functional Information Distribution System-Low Volumn Terminal (MIDS-LVT) program offices along with the 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.</p> <p>Overall goal: Evaluation of the technologically matured 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.</p>		0.701	4.095	0.356	

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B. Accomplishments/Planned Program (\$ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
<p><i>FY 2008 Accomplishments:</i> Link-16 gateway enhancements for evaluation and selection. Plans called for the assessment of technical maturity of data link, network and voice communications capability to be used for airborne network gateway candidates. Initiated the development of enhancements to support shortfalls discovered. Initiated the development of technology transition criteria.</p> <p><i>FY 2009 Plans:</i> 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 technical maturity of candidates. Conduct military utility assessment. Continue development for follow on assessment and technology maturation.</p> <p><i>FY 2010 Plans:</i> Complete selection and demonstration of technologies. Transition to the JTIDs, MIDS-LVT and MIDS-Joint Tactical Radio System (JTRS) programs.</p>				
<p>Airborne Tactical Relay</p> <p>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.</p> <p>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.</p>	2.400	6.289	2.400	

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B. Accomplishments/Planned Program (\$ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
<p><i>FY 2008 Accomplishments:</i> Platforms and payloads selected. Developed, integrated and tested the payloads; procured (leased) platforms (UAV, ground terminals and portable equipment); completed payload to platform integration for operational demonstration. Established the concept of operations and operational scenario. Conducted the military utility assessment. Initiated technology transition criteria.</p> <p><i>FY 2009 Plans:</i> Procure (buy) platforms; Develop additional 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. Investigate usage of different payloads.</p> <p><i>FY 2010 Plans:</i> Complete demonstration of operational relay capability. Transition to Marine and Army Partners</p>				
<p>Gateway Interoperability</p> <p>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 (GiG), specifically in the area of the tactical edge attachment to the GIG core networks.</p> <p><i>FY 2009 Plans:</i> 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.</p> <p><i>FY 2010 Plans:</i> Build prototype gateway for Army and Marine Networks. Transition to programs of record.</p>	0.000	4.496	6.000	

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

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COST (\$ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
P663: Network Communications Analysis	25.967	14.879	19.456						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) JASONS 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, spectrum management affects 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 enough to 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.

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<p>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.</p>				
B. Accomplishments/Planned Program (\$ in Millions)				
	FY 2008	FY 2009	FY 2010	FY 2011
<p>Integrated Network Management Capability</p> <p>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 Systems (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 WIN-T, 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><i>FY 2008 Accomplishments:</i> Interface Control Working Group was established. Established federated testbeds at Army, Navy and Air Force research facilities to explore how individual network management tools work together in</p>	4.484	4.056	5.031	

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B. Accomplishments/Planned Program (\$ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
<p>diverse tactical networks. Initiated development of integrated management tools. Established network management data library.</p> <p><i>FY 2009 Plans:</i> 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. Work to increase participation (submission and usage) of network management data library.</p> <p><i>FY 2010 Plans:</i> Demonstrate tools in an operational environment, transition tool set. Initiate selection and evaluation of next generation integrated network management software tools.</p>				
<p>Network Management Tools and Analysis</p> <p>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.</p> <p>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.</p> <p><i>FY 2008 Accomplishments:</i> Air Force and Army evaluated jointly selected policy-based Network Management tools. Measurement-based tactical network management tools developed by the Navy. Shared results and tools in a collaborative environment (called the Joint NETOPS Integrated Collaborative Working Group). Assessed network management tools for the military tactical mobile networking environment in operational and laboratory testbed environments.</p>	2.666	4.145	5.259	

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B. Accomplishments/Planned Program (\$ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
<p><i>FY 2009 Plans:</i> Further develop and demonstrate management tools to evaluate technical maturity and military utility. Initiate technology transition planning. Plan to expand testing of Navy network management tools to tactical scenarios. Continue to conduct validation of tools in testbed facilities..</p> <p><i>FY 2010 Plans:</i> Transition tools to existing programs; Initiate selection and evaluation of next generation Network Management tool set.</p>				
<p>Spectrum Management Tools and Analysis</p> <p>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.</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><i>FY 2008 Accomplishments:</i> Developed the spectrum technology strategy for the introduction of advanced capability beyond operational mission planning. Demonstrated technologies to support monitoring and planned adjustments as spectrum conditions allow (Dynamic Spectrum Access Capabilities). Assessed emerging spectrum technologies for inclusion to support military operations. Developed dynamic spectrum access (DSA) architecture.</p> <p><i>FY 2009 Plans:</i> Expand program into spectrum-aware, cognitive networking (antenna and radio capabilities) for existing tactical networks. Demonstrate concepts and technologies to support a more efficient and effective use of spectrum. Initiate collaborative research among the Services. Investigate transition areas.</p>	1.543	2.973	4.538	

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B. Accomplishments/Planned Program (\$ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
<p><i>FY 2010 Plans:</i> Demonstrate and transition technologies for spectrum management. Initiate identification and evaluation of next generation Spectrum Management tool set.</p>				
<p>Tactical Mobile Networking</p> <p>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 by the Navy and Air Force. Results planned for transition to programs of record as maturity of models allow.</p> <p>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.</p> <p><i>FY 2008 Accomplishments:</i> Work was executed by the Navy and Air Force. Completed initial analysis of the technical parameters to be met for tactical mobile networking. Evaluated modeling and simulation along with design and analysis tools to support tactical mobile networking. Initiated the development of an improved set of tools to support tactical mobile networking and evaluate tools in an experimental setting.</p> <p><i>FY 2009 Plans:</i> Initiate 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. Explore areas for cross-service collaboration. Explore transition opportunities for tool set.</p>	1.761	3.705	4.628	

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B. Accomplishments/Planned Program (\$ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
<i>FY 2010 Plans:</i> Continue work in cognitive networking, demonstrate architectures and tools in testbeds and operational evaluations.				
<p>Netted Iridium</p> <p>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.</p> <p><i>FY 2008 Accomplishments:</i> Completed basic (radio only) and advanced models of the NI radio. Conducted several user assessments to demonstrate the NI capability.</p>	15.513	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				

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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 testbed development; prototype software demonstrated; prototype architectures developed		

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