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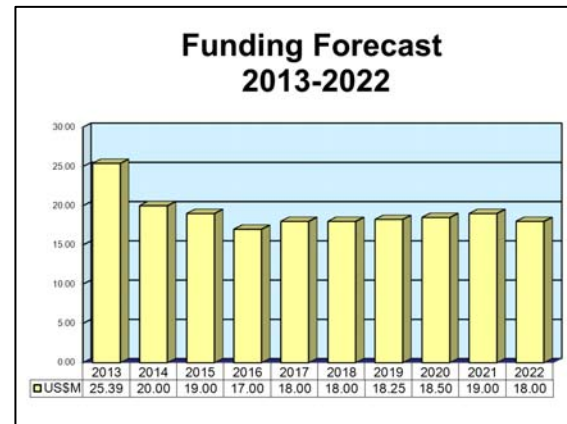
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Network Communications Analysis

Outlook

- FI projects that the U.S. DoD will spend about \$190 million on its Network Communications Analysis project over the next decade
- The tactical mobile networking needs of the U.S. military are driving the project's funding forecast
- In FY14, look for the Tactical Networking Evolution and Expansion project to begin the demonstration planning phase of the Asymmetric Broadcast Command and Control System



Orientation

Description. The Network Communications Analysis project is a United States Department of Defense research and development undertaking. The project establishes the scientific foundations for military tactical mobile networking with a specific emphasis on the integrated network management of tactical networks.

Status. Ongoing research and development.

Application. Tactical mobile network communications.

Sponsor

U.S. Department of Defense
Pentagon
Washington, DC 20310

Contractors

Contractor(s) not selected or not disclosed.

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Services/Governments & Industries) or call + 1 (203) 426-0800.

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Technical Data

U.S. warfighters today rely increasingly on communications networks to support and enable actions from targeting and shooting weapons to videoconferencing back home. Although basic military

infrastructure capabilities follow the mainstream commercial Internet, for many reasons (including security, mobility, and robustness) commercial telecommunications – especially commercial wireless,

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or "tactical edge," communications – are not well matched with the requirements of today's warfighter. According to the Pentagon, these trends will continue as the military data load becomes more diverse and heavy. The Network Communications Analysis project will establish the scientific foundations for military tactical mobile networking, with a specific emphasis on the integrated management of tactical networks.

The project is part of PE#0603662D8Z (Networked Communications Capability). It consists of the following subprojects:

Tactical Mobile Networking. The National Research Council's Network Science Report (2005) and U.S. Army Mobile Ad-hoc Network (MANET) Jason Report (January 2006) state that the type of networking projected to meet military tactical requirements is not supported by network theory, network design, or analysis tools. In response to the findings of these reports, the Tactical Mobile Networking project 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 are conducted to support tactical mobile networking environments. This project will also explore the role of network experimentation in network modeling. Additionally, the project will recommend design tools, architectures, and technical approaches to acquisition programs in response to the findings of the research conducted under the project.

Network Management Tools and Analysis. Network management in the commercial world is highly organized and synchronized. Activity is well monitored, and disrupted networks are efficiently repaired as required. But the tools used commercially are ill matched for military tactical mobile networking.

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 operations. Management tools that ensure continued secure and robust operations – something not achievable with commercial wireless technologies – need to be in place. The Network Management Tools and Analysis project will assess the military network management tools currently in place and develop technology and tools to address shortfalls.

Spectrum Management Tools and Analysis. The demand for spectrum is increasing due to the

expanded use of sensors, imagery, and voice. This demand places added pressure on the limited radio frequency (RF) spectrum for military tactical networking. The current U.S. DoD frequency planning and management infrastructure copes with this demand through operational planning, in addition to application of the Coalition Joint Spectrum Management Planning Tool (a Joint Capability Technology Demonstration project managed by the U.S. Army) and the Global Electromagnetic Spectrum Information System.

Advanced spectrum management concepts such as sense and adapt, spectrum sharing, and dynamic reallocation are under investigation, but are not yet mature enough to support operations. The Spectrum Management Tools and Analysis project will evaluate opportunities for more efficient and effective use of the DoD's frequency spectrum. Technology advances are expected to further the employment of cognitive radio devices to adapt operations based on spectrum policy and usage, the management of multiband and multifunction apertures, and the use of spectrum-efficient waveforms in military environments. The Spectrum Management Tools and Analysis project will develop the models and tools necessary to demonstrate these technologies as they are introduced.

Integrated Network Management Capability. Network management becomes more complex as more types of networking capabilities 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. The Integrated Network Management Capability project will define integrated operations tools for all aspects of network resource management. The project will also develop testbeds specially designed to validate models and simulations used to test network management tools.

Tactical Networking Evolution and Expansion. The Tactical Networking Evolution and Expansion project develops new applications and approaches that can be used on existing tactical networks to improve the physical and networking layers for the tactical warfighter. The project explores 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.

Program Review

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As mentioned, the Network Communications Analysis project is composed of the following subprojects:

Tactical Mobile Networking. In FY08, the Tactical Mobile Networking project worked on evaluating network design and analysis tools to support military tactical mobile networking environments. In FY09, the networking project began research into other areas applicable to the joint tactical environment, such as "cognitive networking." The project also continued its work developing an improved set of tools to support tactical mobile networking.

In FY10, the project continued its work conducting research in cognitive networking. In FY11, it worked on developing a UAV-based cloud computing architecture to provide assured computing capacity on demand at the tactical edge.

In FY12, the project worked on developing a wireless MapReduce implementation for UAV-based airborne cloud computing to support fast decision-making at the edge of an enterprise. In FY13, the project worked on enhancing the Adaptive Reliable Video Service (ARVIS).

According to a U.S. DoD FY14 budget document, no work is scheduled for FY14.

Network Management Tools and Analysis. In FY08, the Network Management Tools and Analysis project assessed existing network management tools for the military tactical mobile networking environment in operational as well as laboratory testbed environments. In FY09, the project continued further development of network management tools. In FY10, the project began selecting and evaluating a next-generation network management tool set.

From FY11 through FY12, the project worked on incorporating additional network operations/situational awareness components to its set of network management tools.

In FY13, the project worked on integrating real radios and networks into an emulation environment in order to demonstrate operation of a universal interface and to verify the feasibility of configuring and monitoring real communications equipment.

According to a U.S. DoD FY14 budget document, no work is scheduled for FY14.

Spectrum Management Tools and Analysis. In FY08, the Spectrum Management Tools and Analysis project developed the radio frequency spectrum technology strategy for the introduction of advanced capability beyond operational mission planning. In

FY09, the project began demonstrating concepts and technologies to support a more efficient and effective use of spectrum. In FY10, it started identifying and evaluating a next-generation spectrum management tool set.

In FY11, the project worked on integrating a next-generation spectrum management tool set in existing operational environments, such as spectrum management centers. In FY12, the project continued cognitive radio testbed research and produced reports and documentation on findings.

In FY13, the project worked on analyzing the multicast throughput and stability for a two-user cognitive radio system, as well as analyzing the capacity-delay tradeoffs in cognitive radio networks.

According to a U.S. DoD FY14 budget document, no work is scheduled for FY14.

Integrated Network Management Capability. In FY08, the Integrated Network Management Capability project developed federated testbeds to explore how individual network management tools work together in diverse tactical networks. In FY09, the management capability project continued defining an integrated network management framework.

In FY10, the project began selecting and evaluating next-generation integrated network management software tools. In FY11, the project began integrating next-generation network management software tools in existing operational environments (for example, TNOCS and JTF-GNO).

In FY12, the project worked on developing a "user-friendly" virtual network configuration and management toolset. In FY13, the project conducted research on large-scale network emulation experiments.

According to a U.S. DoD FY14 budget document, no work is scheduled for FY14.

Tactical Networking Evolution and Expansion. In FY11, the project began developing early prototypes for anti-jam improvement field-testing. In FY12, the project worked on developing more efficient multicast routing schemes for directional antenna mobile routing networks.

In FY13, the project worked on developing a Multifunctional Electronic Warfare (EW) and Communications Waveform (CW) capable of providing simultaneous communications and EW functions.

In FY14, look for the project to begin the demonstration planning phase of the Asymmetric Broadcast Command and Control System (ABC2).

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Funding

U.S. FUNDING							
	FY12 <u>QTY</u>	FY12 <u>AMT</u>	FY13 <u>QTY</u>	FY13 <u>AMT</u>	FY14 <u>QTY</u>	FY14 <u>AMT</u>	
RDT&E (OSD)							
PE#0603662D8Z, Project 663		20.86		25.39			20.00
	FY15 <u>QTY</u>	FY15 <u>AMT</u>	FY16 <u>QTY</u>	FY16 <u>AMT</u>	FY17 <u>QTY</u>	FY17 <u>AMT</u>	FY18 <u>QTY</u>
RDT&E (OSD)							
PE#0603662D8Z, Project 663		TBD		TBD		TBD	TBD

All \$ are in millions.

Source: U.S. Office of the Secretary of Defense FY14 budget document

TBD = To Be Determined

Contracts/Orders & Options

No contract information regarding the Network Communications Analysis project has been made public.

Timetable

<u>Year</u>	<u>Major Development</u>
FY08	Integrated Network Management Capability project develops federated testbeds to explore how individual network management tools work together in diverse tactical networks
FY09	Tactical Mobile Networking project continues to develop an improved set of tools to support tactical mobile networking
FY10	Spectrum Management Tools and Analysis project starts identifying and evaluating a next-generation spectrum management tool set
FY11	Tactical Networking Evolution and Expansion project starts developing early prototypes for anti-jam improvements field-testing
FY12	Tactical Mobile Networking project works on creating a wireless MapReduce implementation for UAV-based airborne cloud computing
FY13	The Tactical Networking Evolution and Expansion project works on developing a Multifunctional Electronic Warfare (EW) and Communications Waveform (CW) capable of providing simultaneous communications and EW functions
FY14	Look for the Tactical Networking Evolution and Expansion project to start the demonstration planning phase of the Asymmetric Broadcast Command and Control System

Worldwide Distribution/Inventories

The Network Communications Analysis project is a **U.S. Department of Defense** program.

Network Communications Analysis

Forecast Rationale

The Network Communications Analysis project is a U.S. Department of Defense research and development undertaking. The project establishes the scientific foundations for military tactical mobile networking with a specific emphasis on the integrated network management of tactical networks.

Forecast International projects that the DoD will spend more than \$175 million on its Network

Communications Analysis project over the next ten-plus years. The tactical mobile networking needs of the U.S. military services are driving FI's funding forecast.

FI believes funding for the Network Communications Analysis project should average about \$21 million annually over the next three years, despite the cost-cutting climate in Washington.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR RDT&E FUNDING (in millions \$)												
Designation or Program		High Confidence				Good Confidence			Speculative			
	Thru 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
MFR Varies												
NETWORK COMMUNICATIONS ANALYSIS Military <> United States <> Department of Defense												
	110.21	25.39	20.00	19.00	17.00	18.00	18.00	18.25	18.50	19.00	18.00	191.14
Total	110.21	25.39	20.00	19.00	17.00	18.00	18.00	18.25	18.50	19.00	18.00	191.14