

# DARPA NETWORK CHALLENGE

Fiscal Year 2010 Report

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Defense Advanced Research Projects Agency

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## **1 BACKGROUND**

Section 2374a of Title 10 of the United States Code authorizes the Secretary of Defense, acting through the Director, Defense Research and Engineering (DDR&E), and the Service acquisition executive of each military department, to conduct programs to award up to \$10 million in cash prizes to recognize outstanding achievements in basic, advanced, and applied research; technology development; and prototype developments that are potentially applicable to the military missions of the Department of Defense (DoD) (see Appendix A). DDR&E delegated this authority to the Director of the Defense Advanced Research Projects Agency (DARPA) and authorized the conduct of the DARPA Network Challenge featuring a \$40,000 cash prize for the winner.

This document describes DARPA's FY 2010 activities under the delegated prize authority.

The DARPA Network Challenge was held on December 5, 2009. A total prize purse of \$40,000 was offered to the first person or team to report the locations of 10 red 10-foot-diameter weather balloons moored at previously undisclosed sites across the contiguous United States. The timing of the event was chosen to commemorate the 40<sup>th</sup> anniversary of the Internet.

A team from the Massachusetts Institute of Technology made use of social networking technologies and a recursive incentive scheme to report all 10 locations in 8 hours 52 minutes. This achievement demonstrates the potential value of human networks to solve sensing problems that would be nearly impossible by conventional intelligence methods.

## **2 PROGRAM GOALS**

Intelligence, surveillance, and reconnaissance (ISR) systems are increasingly important for military operations and National defense, relying primarily on very sophisticated, very expensive assets. Alternatively, a distributed human sensor network activated by an appropriate incentive scheme has the potential to augment and, in some cases, replace these systems using established technologies at a much lower cost. The objective of the DARPA Network Challenge was to investigate these issues and demonstrate this potential making use of the prize authority.

Specifically, the program goals were to:

- Demonstrate the use of a distributed human sensor based on the Internet and social networking technologies to solve a seemingly impossible ISR problem covering a vast geographic area in a short amount of time, and
- Examine the use of social networking technologies to enable self-organization and mobilization of individuals to form and organize groups to solve these problems.

### **3 PRIZE AUTHORITY UTILIZATION**

To execute the DARPA Network Challenge, an incentive scheme was required to energize the creation of teams capable of completing the Challenge. To accomplish this goal, a cash prize was offered to an individual or group able to recruit members and coordinate the overall balloon search effort. Participation incentives and widescale outreach required the prize authority mechanism; the event would not be possible with standard authorities such as contracts, grants, or cooperative agreements. Prize authority made it possible for DARPA to work with thousands of individuals, most of whom had never worked previously with DoD in any capacity.

### **4 CASH PRIZES AWARDED**

The winner was announced, and the prize was awarded at the completion of the Challenge on December 5, 2009.

The MIT Red Balloon Challenge Team from Cambridge, Massachusetts, was awarded \$40,000 as the first team to report correctly the locations of all 10 balloons.

### **5 SOLICITATION AND EVALUATION METHODS**

The DARPA Network Challenge was announced on October 29, 2009, in a webcast from a symposium at the University of California, Los Angeles marking the anniversary of first message transmitted over the Internet. The announcement press release was posted shortly thereafter on the DARPA homepage and was widely reported in national and international media such as *The New York Times*, MSNBC, and National Public Radio.

News of the event progressed virally over the Internet, as individual competitors spread the news via YouTube, blogs, and Twitter. Teams created recruitment videos and websites to attract followers. Traditional mass media stories in the last week before the Challenge boosted awareness significantly, as web site visits accelerated from approximately 1,000 per day to more than 20,000 per day. Outreach ultimately required a combination of both new and traditional media.

A total of 4,367 individuals registered for the event, including 189 international registrants from 39 countries. Although participants from universities were common, many individual teams were formed solely for the purpose of participating in the event.

The rules tacitly allowed an online market to develop for balloon sighting information. Teams quickly found themselves faced with common online problems such as information provenance and attribution. Spoofing, intentional misinformation, viruses, and doctored evidence such as photo-edited balloon sighting photos were observed. Successful teams managed to validate sightings despite the adversarial environment using, for example, forensic tools to map IP

addresses and the discernment of subtle variations in communication patterns to discern malicious intent.

Two or more balloons were found by 58 teams, and 19 teams found more than five.

## 6 RESOURCES USED

The DARPA Network Challenge was conducted on a Saturday and made use of Government staff members, military interns, and support contractors to carry out the event. Two staff members were used at each balloon site to manage logistics and interact with participants.

Prize funds were drawn from the program elements (PE) and projects as follows:

PE	Project	Title	FY09	Total
0601101E	CCS-02	Math and Computer Sciences	40,000	40,000
				<b>\$40,000</b>

## 7 TECHNOLOGY TRANSITION

The DARPA Network Challenge was a successful demonstration of the potential of a human network to solve ISR problems that would be unfeasible by any other means. Subsequent to the event, DARPA discussed the results, methods employed, and potential ramifications with several organizations within the law enforcement, military, and intelligence communities. In addition, the 10 DARPA Service Chief Fellows essential to the planning and execution of the event have brought the lessons of this experience to their respective Military Services.

## 8 CONCLUSION

The DARPA Network Challenge achieved its goals and stimulated interest in the programs and projects of interest to the DoD science and technology community. It attracted a large pool of nontraditional participants and demonstrated a result that is far outside the DoD mainstream. Although organizers prepared for the event to extend over several days, the remarkable efficiency of the human network in solving the Challenge in under 9 hours despite the harsh adversarial environment points toward new directions in attacking intractable problems and promises to inspire a new class of approaches to national security.

## APPENDIX A PRIZE AUTHORITY STATUTE

The prize authority statute, section 2374a of U.S. Code Title 10 was amended by Section 257 of the National Defense Authorization Act of 2006 and Section 212 of the National Defense Authorization Act of 2007 as follows:

### § 2374a. Prizes for advanced technology achievements

**(a) Authority.** The Secretary of Defense, acting through the Director of Defense Research and Engineering and the service acquisition executive for each military department, may carry out programs to award cash prizes in recognition of outstanding achievements in basic, advanced, and applied research, technology development, and prototype development that have the potential for application to the performance of the military missions of the Department of Defense.

**(b) Competition requirements.** Each program under subsection (a) shall use a competitive process for the selection of recipients of cash prizes. The process shall include the widely-advertised solicitation of submissions of research results, technology developments, and prototypes.

**(c) Limitations.**

**(1)** The total amount made available for award of cash prizes in a fiscal year may not exceed \$10,000,000.

**(2)** No prize competition may result in the award of more than \$1,000,000 in cash prizes without the approval of the Under Secretary of Defense for Acquisition, Technology, and Logistics.

**(d) Relationship to other authority.** A program under subsection (a) may be carried out in conjunction with or in addition to the exercise of any other authority of an official referred to in that subsection to acquire, support, or stimulate basic, advanced and applied research, technology development, or prototype projects.

**(e) Annual report.—**

**“(1) In general.—**Not later than March 1 of each year, the Secretary shall submit to the Committee on Armed Services of the Senate and the Committee on Armed Services of the House of Representatives a report on the activities carried out during the preceding fiscal year under the authority in subsection (a).

**“(2) Information included.—**The report for a fiscal year under this subsection shall include, for each program under subsection (a), the following:

**“(A) A description of the proposed goals** of the competitions established under the program, including the areas of research, technology development, or prototype

development to be promoted by such competitions and the relationship of such areas to the military missions of the Department of Defense.

“(B) An analysis of why the utilization of the authority in subsection (a) was the preferable method of achieving the goals described in subparagraph (A) as opposed to other authorities available to the Department, such as contracts, grants, and cooperative agreements.

“(C) The total amount of cash prizes awarded under the program, including a description of the manner in which the amounts of cash prizes awarded and claimed were allocated among the accounts of the Department for recording as obligations and expenditures.

“(D) The methods used for the solicitation and evaluation of submissions under the program, together with an assessment of the effectiveness of such methods.

“(E) A description of the resources, including personnel and funding, used in the execution of the program, together with a detailed description of the activities for which such resources were used and an accounting of how funding for execution was allocated among the accounts of the Department for recording as obligations and expenditures.

“(F) A description of any plans to transition the technologies or prototypes developed as a result of the program into an acquisition program of the Department.

**(3) Suspension of the authority for failure to include information.**—For each program under subsection (a), the authority to obligate or expend funds under that program is suspended as of the date specified in paragraph (1) if the Secretary does not, by that date, submit a report that includes, for that program, all the information required by paragraph (2). As of the date on which the Secretary does submit a report that includes, for that program, all the information required by paragraph (2), the suspension is lifted.

**(f) Period of authority.** The authority to award prizes under subsection (a) shall terminate at the end of September 30, 2013.

## APPENDIX B TARGET LOCATIONS



**APPENDIX C      TOP 10 TEAMS**

<b>Place</b>	<b>Team Name</b>	<b>Hometown</b>	<b>Balloons Found</b>
1	MIT Red Balloon Challenge Team	Cambridge, MA	10
2	GTRI "I Spy a Red Balloon" Team	Atlanta, GA	9
3	Chris Rodriguez and Tara Chang	Cambridge, MA	8
4	Dude It's a Balloon	Glen Rock, NJ	8
5	Groundspeak Geocachers	Seattle, WA	7
6	Army of Eyes - Mutual Mobile, Inc.	Austin, TX	7
7	Team DeciNena	Evergreen, CO	7
8	Anonymous	Anonymous	7
9	Nerdfighters	Missoula, MT	7
10	iSchools DARPA Challenge Team	State College, PA	6