

Testimony of the Honorable Tara O’Toole, M.D., MPH
Under Secretary for Science and Technology
U.S. Department of Homeland Security

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Introduction

Good morning Chairman Lungren, Ranking Member Clarke, and distinguished members of the Committee. Thank you for the opportunity to testify before you today on behalf of the Department of Homeland Security (DHS) Science and Technology Directorate (S&T). My testimony will describe the Directorate’s strategic direction and top priorities of our directorate while highlighting some of our successes in support of the third largest federal agency in a time of austere budgets. Over the past two years, the Directorate has built on the achievements of the initial years of DHS to create an organization with a growing ability to help the Homeland Security Enterprise achieve its missions. S&T is building stronger partnerships with first responders and DHS Components to gain a deeper understanding of their top needs and operational environments. We have focused our technology development process to rapidly deliver technologies to use in the field. We have expanded the application of the technical talent of S&T’s engineers and scientists to include assessments of operational problems and acquisition requirements. And we have embarked on an ambitious effort to make the best possible use of taxpayers’ dollars through identifying technology investments made by others which might meet homeland security needs through collaborations with others in the federal government, universities, the private sector and abroad

Mission of the DHS S&T Directorate is Broad, Varied and Serves Many Partners

The mission of DHS S&T is to *strengthen America’s security and resiliency by providing knowledge products and innovative technology solutions for the Homeland Security Enterprise*. Congress created the S&T Directorate as part of the Homeland Security Act of 2002, to “conduct basic and applied research, development, demonstration, testing and evaluation activities relevant to any or all elements of the Department.”¹ S&T also has a statutory responsibility to transfer useful technologies and information to first responder communities, state and local governments, and to the private sector.

In the past eight years, S&T has undergone many changes and continues to evolve. The extraordinary breadth and diversity of DHS’s missions requires S&T to address a wide range of programs including Components’ near-term needs for new operational capabilities and improved operational effectiveness, efficiency and safety. S&T also has responsibilities related to understanding and creating solutions to biological and chemical threats, and to conducting the research and development (R&D) required to meet homeland cyber security needs. Investments

¹ 6 U.S.C. Sec. 182(4)

in near-term, incremental solutions must be balanced against investments in potentially game-changing technologies that will take longer to mature.

DHS S&T's work is usually identified with technology development, but equally as important are the Directorate's contributions to homeland security in the form of analyses or "knowledge products." These include analyses of alternative technological options; assessments of complex issues such as the relative risk of different biological or chemical threat agents; operational testing and evaluation of technologies proposed for acquisition; and the creation of consensus standards which enable cost-effective progress across many fields. Additionally, over the past year, S&T has begun a major strategic effort, in collaboration with the Under Secretary for Management, to improve DHS acquisition processes.

Investing S&T's Resources: Maximizing Benefit, Balancing Risk

S&T fully recognizes the need to be a responsible steward of taxpayers' dollars and to clearly demonstrate the value the S&T Directorate brings to the Homeland Security Enterprise (HSE). This is particularly important in R&D endeavors, where the time between initial research investments and useable products is typically measured in years or even decades, and where risk - and the possibility of failure - is necessarily part of the picture. New technological capabilities and the design of sound analytical processes and acquisition decisions offer solutions to many of the challenges confronting the Department and are also essential, potentially powerful cost-saving tools. Moreover, the scope of the HSE's need for technologies and technical assistance requires that we make careful judgments about where to invest S&T's limited resources. My predecessor as Under Secretary established Integrated Product Teams consisting of representatives from DHS Components, whose purpose was to select and rank "capability gaps" which S&T then tried to address through technology development. This was an important step in linking S&T activities to Components' needs, but the selected projects sometimes failed to reflect the strategic priorities of the leadership. In addition, some projects yielded successful prototypes but failed to transition to actual use in the field, sometimes because research efforts in S&T were not paired with Component acquisition programs, sometimes because Components' priorities had shifted, and sometimes because there were no funds to support realistic pilots and training programs. Due to these shortcomings, S&T has established the goal of transitioning R&D products to use as a top priority. To achieve this end, we made several changes to the process for selecting R&D projects.

Ongoing Review of the R&D Portfolio

All individual R&D projects, including proposed "new starts," undergo evaluation using a "portfolio review" process to ensure that they are supported by operational partners (i.e. one or more DHS Component or First Responder communities), are technically sound, have the potential to make a meaningful mission impact, and are progressing adequately. Each project is judged against specific metrics, determined by S&T with input from the Components, designed to address elements essential to programmatic success in the context of DHS's Quadrennial Homeland Security Review (QHSR) missions. These metrics assess the project against six strategic imperatives, namely:

- **Impact:** Is our portfolio making a significant impact on our customer's mission?
- **Transition:** Are we transitioning relevant products to the field?

- **Technical Positioning:** Is our investment positioning the organization for the future?
- **Customer Alignment:** Are our projects aligned with well-understood customer requirements?
- **Customer Involvement:** Do we have the appropriate level of customer interaction?
- **Innovation:** Are we sufficiently innovative in the way we approach our challenges?

Measuring all of our projects against this framework provides a transparent and "shareable" view of all R&D within S&T; enables more strategic, longer-term budget decisions; ensures efficient delivery to the component or end user; and nurtures effective communication throughout the process. This particular review model has been used by both Federal and private R&D organizations, including the prize-winning Army Engineering, Research and Development Laboratory in Mississippi.

A major observation stemming from the first review of the R&D portfolio in 2009 was that S&T was pursuing a much larger number of projects than could be adequately supported within our budget. Many projects were failing or languishing for years because they lacked the resources needed to succeed. Thus we decided to reduce the number of projects, instill annual reviews of budget adequacy and progress, and fund each selected project through to "use in the field", whether it was transition to a commercial venture or a DHS pilot operation. This strategy resulted in some projects receiving more funds, while others were eliminated or significantly reformulated. Additionally, we placed a greater emphasis on integration of projects with the DHS Component partners' operational needs and acquisition planning cycles because even the highest impact project is of little utility without the Components' ability to procure it. We have already begun to see the fruit of these decisions.

Apex Projects Demonstrate the Importance of Strong Partnerships between S&T and Operators

Apex projects are intended to solve problems of strategic operational importance identified by a Component leader. The Apex model is designed to demonstrate a new framework for working with Components, based on top-level commitment to the project, collaborative partnerships and multidisciplinary teams. Each Apex project is codified in a signed charter agreement between the head of a DHS Component and the Under Secretary for S&T. Together, we approve the project's goals and approach, providing a leadership imprimatur which energizes both S&T and the partner organization. The S&T team is then mirrored by an equally able, multidisciplinary team from the partner Component. The first Apex effort focused on improving the remote protective operations of the U.S. Secret Service (USSS) and has proven very successful. Another Apex initiative, which began in March 2011, is a partnership with U.S. Customs and Border Protection to develop a secure transit corridor for goods shipped between Mexico, the U.S., and Canada.

A key lesson of the Apex experience is that forging a *true partnership* between the technical team and the operators is essential to success. Going forward, S&T will be more likely to invest its resources in areas where operators – whether they are DHS Components or first responders – are willing to actively collaborate on the project. Innovation requires a deep, precise understanding of the problem to be solved. This requires insights from operators, who best know the needs and constraints of the operational reality, and technical experts who have a grasp of the

range of available solutions and how to analyze possible trade-offs. Equally as important is the imperative to integrate new technologies or analytical approaches into the whole “system” that makes up the operational reality. For example, technologies which are extremely expensive, require constant care and feeding, or intensive training are not suitable to many DHS operations.

S&T Resource Allocation Strategy: Creating a Balanced, High Impact R&D Portfolio

To better support the entire Homeland Security Enterprise, we are developing an S&T Resource Allocation Strategy (STRAS) which reflects lessons learned from our Apex experience and reviews of our R&D portfolio as well as dialogue among representatives from the Components, the first responder community, and S&T.

STRAS is highly collaborative and based on focused interactions with partner organizations coupled with a rigorous examination of the problems at hand. STRAS begins with an understanding of S&T’s current research and development efforts on behalf of Components as well as ongoing internal, Component-sponsored R&D efforts. The systems analysis explicitly maps how the operational process functions and highlights potential capability gaps. Based on this systems analysis and understanding of the ongoing R&D efforts, a strategic plan will be jointly developed and agreed to by the Component and S&T. A formal written agreement will codify the joint effort; periodic updates will ensure that projects are progressing and will ultimately lead to fielding of an operational capability, including, if appropriate, the transition of research products and prototype technologies into field pilots and acquisition plans. This strategic approach to S&T resourcing allows for development of a managed, balanced portfolio, but retains the inherent flexibility to support "out-of-cycle" or emergent Component requests for assistance.

S&T uses a modified version of the STRAS process to identify efforts for the first responder community. S&T’s First Responder Group, which was created during the 2010 strategic realignment, is entirely focused on connecting with and addressing the needs of first responders. We use a variety of nationwide outreach methods to examine and identify appropriate local, state, and Federal roles and responsibilities for developing response capabilities. These groups further ensure that technology, training, and policy investments by S&T and the Federal Emergency Management Agency are aligned with these capabilities and best support the priorities of the first response community. Key partners such as the InterAgency Board for Equipment Standardization and Interoperability and S&T’s First Responder Resource Group help us capture the diverse voice of the emergency response community’s needs and goals for policy, operational doctrine, and technology – with the ultimate goal of meeting the challenges of catastrophic mission response. S&T analyzes these practitioner-identified gaps to select projects for investment. Multiple jurisdictions across the country have partnered with S&T to host pilots and operational demonstrations of research products to field commercially viable, operationally tested technologies.

Beyond R&D: Using S&T’s Technical Expertise to Provide Analytical Support to DHS

S&T’s work extends beyond technology development. Component support also includes operational analysis, requirements generation, test and evaluation, and acquisition support. Through the leadership of our Acquisition Support and Operations Analysis (ASOA) group,

S&T has been formally incorporated into DHS's new integrated investment lifecycle - we will be working on the "front end" of the acquisition process assisting in the development of technically specific and feasible requirements. Getting requirements right on the "front end" greatly improves the odds of a successful transition at the end of the program. S&T provides systems engineering support throughout the "middle" of the investment lifecycle to assist Components with items such as risk management and ConOps development.

Additionally, S&T has a statutory responsibility on the "back end" of acquisition in testing and evaluation. S&T has been at the forefront of improving the Department's overall acquisition process through the establishment of DHS' operational test and evaluation (OT&E) process. The OT&E process ensures that programs that come before the Acquisition Review Board have been thoroughly and appropriately vetted. This is the final step before the Department makes significant investment into final production and fielding of the acquired system ensures that the system meets its documented operational requirements and provides the required capability.

A Model for High Impact: Leveraging Investments by Others and Creating Productive Collaborations

Wherever possible, S&T attempts to identify R&D activities in which others have already invested and then adopt, adapt, or further develop these investments to satisfy the needs of the HSE. The austere budget realities facing the U.S. and our allies will likely encourage collaboration as organizations seek to augment their own R&D investments with outside resources.

Technology Foraging: Higher ROI, Faster Transitions

S&T is committed to getting as high of a return on investment (ROI) of resources as possible. To this end, and to meet our goal of rapidly delivering products to use, we are establishing "technology foraging" as part of every technology development project. Technology foraging refers to a complex process of scanning the horizon for technologies that are already in use or being developed, and adopting these technologies for new purposes, new environmental conditions, or at new scales. Technology foraging leverages the work being done by industry, in other federal agencies, at universities, and by our international partners, against possible applications to DHS's needs. It is an extremely challenging task because of the vast and continuously shifting body of R&D unfolding in public and private sectors around the world. However, when done correctly, technology foraging can have a large impact on S&T's efficiency and effectiveness. S&T is moving to a more disciplined and comprehensive approach to technology foraging which requires all project managers to review investments by others in technologies we might adapt or adopt.

For example, the U.S. Coast Guard (USCG) has identified a need to be able to track small vessels approaching a seaport. While most large vessels have communication and tracking devices, along with tagging systems for identification, many small vessels, including those that may be used for illicit activities, called "dark boats" do not. S&T, in partnership with the National Oceanic and Atmospheric Administration (NOAA) and USCG, has developed software that relies on currently deployed coastal NOAA weather radar systems to process the radar signal differently, enabling the USCG to identify and track small vessels.

Private Sector Partnerships: Finding and Importing Good Ideas

Partnering with the private sector is one of S&T's highest priorities. Small business is an important engine of innovation and job creation and S&T utilizes a variety of approaches to engage the private sector. Under my tenure, S&T established the position of Chief Commercialization Officer, which leads engagement with industry. As a result, S&T's coordinated outreach to the private sector has grown considerably. In 2010, S&T interacted with over 6,500 companies informing them on how to work with DHS and soliciting their ideas. Furthermore, better integration and promotion of our research efforts with the private sector has resulted in companies investing their own internal research and development funds to bring S&T-developed technology to the market. One example is Honeywell, Inc.'s investment in S&T's Geo-spatial Location Accountability and Navigation System for Emergency Responders (GLANSER), a tool which allows incident commanders to locate and track personnel inside enclosed areas. Honeywell, Inc. committed over 25 percent of the project's total cost to develop and commercialize GLANSER. Also, Raytheon, Inc. invested 40 percent of the total costs for the Controlled Impact Rescue Tool, a technology that enables first responders to quickly cut through cement to rescue people from collapsed structures.

S&T's Small Business Innovation Research (SBIR) Program actively works to develop technology solutions to homeland security issues that are innovative and accelerate transition into the marketplace. Since its inception in 2004, 316 companies in 43 states received S&T SBIR Phase I awards to demonstrate concept feasibility and one-third of these received Phase II awards, which often culminate in a prototype. Our SBIR program has resulted in 26 patents with 11 more in process. Additionally, 17 products are on the market, including 10 commercial or open source cybersecurity-related products. Not only is S&T finding solutions to homeland security needs, but we are creating new jobs. Fifty-six companies responded to our July 2010 survey and reported that 359 net jobs have been created through SBIR funding.

Collaboration with Other Federal Agencies

DHS S&T staff have been highly active participants and leaders in numerous, ongoing Federal Interagency efforts at both policy and programmatic levels. I co-chair the National Science and Technology Council's Committee on Homeland and National Security, along with Mr. Zack Lemnios of the Department of Defense (DoD) and Mr. Phil Coyle, Associate Director for National Security and International Affairs of the White House Office of Science and Technology Policy. This committee has a comprehensive membership involving key executive branch agencies such as DoD, the Department of Energy, the Department of Health and Human Services (HHS), the Department of Justice, and the Environmental Protection Agency (EPA) and many others. Coordination on this committee enables S&T to form and maintain relationships with other science and technology organizations that can be translated into collaborative programs that maximize and leverage available expertise and resources. Additionally, our scientists serve on 32 Committees and Working Groups across the Interagency. These Working Groups and Committees examine the full range of homeland security issues, such as chemical, biological, radiological/nuclear and explosives (CBRNE) detection and recovery, infrastructure protection, and homeland security policy.

S&T collaboration with other federal agencies also includes a rich array of joint projects to advance mutual goals. To highlight a few examples of S&T partnering with other federal agencies:

- S&T has been working with the Defense Threat Reduction Agency (DTRA), EPA and HHS on several interagency efforts that will increase resilience and recovery following a biological weapons attack, whether the attack targets civilian or military assets.
- S&T and the Defense Advanced Research Projects Agency (DARPA) are collaborating on an effort that is investigating lightweight, blast-resistant materials that will provide enhanced security in shipping air cargo, again benefiting both military and civilian security.
- Working with DoD, DOJ, and the Intelligence Community, we're focusing on the development of two different approaches to verify familial linkages for refugee and asylum and adoption applications. S&T expects to transition this to the U.S. Customs and Immigration Service (USCIS). Our federal partners have contributed \$23.5M to the effort.
- We've partnered with DARPA to leverage their \$25 million basic research investment in advanced data collection and analysis methods to develop the next generation of automated target recognition software for explosive detection systems.
- Working in partnership with DoD and the DOE National Laboratories, we have begun an effort to develop a rapid clinical diagnostic capability that can detect whether someone has been exposed to a range of biothreat agents before symptoms appear.

S&T has also begun engaging with the private sector via investments through In-Q-Tel. In 1999, the Central Intelligence Agency supported the establishment of In-Q-Tel as a not-for-profit strategic investment firm designed to bridge the gap between new advances in commercial technology and the technology needs of the U.S. intelligence and security communities. Most In-Q-Tel investments combine funds from more than one partner agency, allowing S&T to leverage significant investments from the Intelligence Community.

S&T's first project via In-Q-Tel was just announced with a company called Genia Photonics. This company developed a tunable laser source for the medical community and S&T is investigating the feasibility of this technology to perform non-contact, trace explosives detection. S&T expects to close four more In-Q-Tel deals in the next few months. All of these projects are expected to produce transition-ready technologies in the next 12 to 24 months. S&T's total investment of \$6.7 million is leveraging \$11.5 million in investments by other government agencies. In addition, In-Q-Tel reports that \$1 of government investment can attract \$10 in private sector funding.

S&T's collaborations with other agencies at both the policy and programmatic level enable us to reach beyond the resources of DHS alone in order to better provide capabilities that strengthen our homeland security efforts.

University Partnerships

Leveraging the investment and expertise of academia is a key part of S&T's strategy to meet the needs of the Department. To this end, S&T is supporting nine university-based Centers of Excellence (COEs). These consortia of colleges, universities and private sector partners pursue a mixed portfolio of basic and applied research addressing both short- and long-term homeland security needs. DHS Components can directly engage the COEs for specific research; to date, Components have invested a total of \$21.9 million in the Centers. The COEs estimate that they've attracted an additional \$46 million in funding from non-DHS sources including federal, state and local agencies, and private sector partners in 2010.

The COEs have been successful because they've built a reputation for delivering high-impact work with direct, practical application. For example, investigators from the Coastal Hazards COE (CHC) at the University of North Carolina-Chapel Hill assisted the USCG by tracking the likely storm surge/wave impact of Hurricane Irene. CHC's information led the USCG to relocate a Command Center, just before its previous location was damaged by the hurricane. The expertise and foresight of CHC minimized the hurricane's disruptions to USCG's rescue and response operations and the Center has received commendations from the USCG's senior leadership.

International Collaborations

S&T has bilateral agreements with 12 international partners, which enable DHS and other agencies in the HSE to leverage funds, manpower, and facilities in support of our mission. In fiscal year 2011, we had 134 active bilateral projects, including \$15 million in contributions from our international partners. Examples include \$11 million from The Netherlands for a Levee Integrity Monitoring project, \$1.5 million from Singapore to build and test a Hybrid Composite Container, and \$1.2 million from Sweden for the International Submillimeter-Wave Standoff Imager Project, an effort aimed at increasing the capacity to scan large, unstructured crowds for concealed objects, as opposed to conventional checkpoints. Our international projects provide a cost-effective, collaborative approach to common homeland security problem sets, capitalizing on our international partners' expertise and resources.

Selected Achievements of the S&T Directorate

Since I assumed this role, we have made many changes and have achieved some notable successes, even in the face of significant budget constraints. A hallmark of the past two years in S&T has been the unrelenting focus we've placed on transitioning our R&D efforts to use in the field. Commercialization of successful R&D projects is one important means of accomplishing this goal. We have significantly improved our ability to work with private sector partners to commercialize our investments. Another approach to transitioning to use is to closely partner with users throughout the development process to ensure that final products meet users' end needs and are incorporated into Component acquisition plans.

I will briefly enumerate a few of our success stories highlighting the transition to use in the field as well as our analytical and technical capabilities.

Transition to Use in the Field

- S&T partnered with Mine Safety Appliance (MSA) to integrate and certify S&T's lighter and smaller profile, self-contained breathing apparatus (SCBA) cylinder array into a full SCBA ensemble that could be National Fire Protection Association (NFPA) and National Institute for Occupational Safety and Health (NIOSH) tested/certified for use by firefighters. MSA invested its own money for this effort; its financial commitment was equal to 65% of the project's total cost. This will be the first major redesign in decades of this critical piece of first responder safety equipment.
- Consolidated Edison provided almost half of the total project costs to partner with S&T on a new superconducting cable that can join multiple power substations in an interconnected web. This resilient electric grid will help protect against the type of power surges that took down the power grid in the entire Northeast in 2003. Consolidated Edison is installing the S&T technology for testing at its facility in 2013.
- S&T has developed a next generation explosives trace detection device that is ten times more sensitive than existing systems, can detect narcotics as well as explosives, and is similarly priced as existing machines. The FLIR Systems, Inc. device will soon complete TSA qualification testing. S&T anticipates that the device will be commercially available within one year.
- On the cyber front, DHS is responsible for protecting the ".com" and ".gov" cyber-networks. S&T's Domain Name System Security (DNSSEC) project protects the public by preventing internet users from being covertly redirected to malicious websites that look like legitimate sites, such as banks, but attempt to steal personal information. DNSSEC has been and is in wide use by 32 top level domains (such as ".com", ".gov", ".uk", etc.) S&T won the 2011 National Cybersecurity Innovation award for DNSSEC in the category of "Building a Federal Cybersecurity Research Program that Results in Substantial Cyber Risk Reduction".
- S&T, working with the U.S. Department of Agriculture, has developed a next generation vaccine against a strain of Foot and Mouth Disease (FMD). This year the vaccine passed a major milestone and entered live animal trials; it holds the promise of eliminating the billion dollar threat that FMD poses against our nation's agricultural sector. Finally, S&T has had great success in the past two years in improving information sharing for first responders across all levels of government through its Virtual USA (vUSA) program. vUSA is a blend of process and technology that provides a virtual pipeline to allow data, such as the operational status of critical infrastructure, emergency vehicle locations, weather and traffic conditions, and evacuation routes, to be shared by different systems and operating platforms with no changes to current systems. vUSA was chosen as a White House Open Government Initiative and has been used across the country to provide situational awareness and decision support for the DeepWater Horizon oil spill and this year's Mississippi River flooding. States in the Southeast (11 states), Pacific Northwest (4 states), and the Central U.S. Earthquake Consortium (8 states) are currently using vUSA. The network will continue to expand to other state agencies, businesses, and non-profit groups.

Technical and analytical capabilities

- S&T teamed with CBP and the S&T managed Federally Funded Research and Development Center, the Homeland Security Studies and Analysis Institute (HSSAI), to conduct an analysis of alternatives for the Southern border's virtual fence. The result was a recommendation to discontinue the SBInet program and focus on other approaches.
- S&T has worked closely with U.S. Secret Service (USSS) on the Apex Science and Technology for Operational Research Enhancement (STORE) program to deliver needed technologies, and more importantly, help them develop a systems-based approach to show the impact and cost-versus-benefit of technology enhancements on their protective mission. This aspect of the program was essential to USSS's basis for their technology acquisition planning and budgeting process.

Conclusion

The people of S&T constitute the core source of technical expertise available to the Homeland Security Enterprise. In the past two years we have realigned the Directorate's structure, and revised many of the processes by which we choose and pursue our work, and formed valuable partnerships with other R&D organizations, universities, the private sector, and abroad - all with the intent of more effectively and efficiently advancing the missions of the Homeland Security Enterprise. We have made it our first priority to achieve rapid transition of research and development projects to use in the field. We have also expanded the reach of S&T's technical talent to improve DHS project management and acquisition processes.

To these ends, S&T has revamped project selection processes to ensure we are investing in problems of highest importance to HSE operators. We have established Apex projects to enable us to invent and implement solutions to large, complex, high-priority problems. We have demonstrated the power of intensive collaboration and devised processes to make such partnerships a cornerstone of our work, whether with our HSE partners or in collaboration with partner R&D organizations. We are placing a strong emphasis on technology foraging – on seeking and using technology investments by others both to improve S&T's return on investment and to reduce development time. We have reduced the number of projects we pursue, improving the likelihood that chosen efforts have sufficient resources to succeed in a timely way and are carefully tracked throughout development. We have restructured our organization to dedicate significant resources to analysis of operational and acquisition needs and to instill a more systems-oriented approach throughout DHS activities.

Throughout American history, much of the country's wealth, and many of our successes, have come from our ability to forge practical solutions to difficult problems. We have excelled at harnessing science to serve human purposes and to produce innovative technologies which create new capacities that transform once impossible, costly, or dangerous goals into feasible activities. Congress designed S&T to continue this tradition of innovative problem solving in the service of protecting homeland security. I believe the S&T Directorate is making significant contributions to these ends and is becoming increasingly better prepared to make such contributions. This progress is due to the hard work of S&T's people, to our deepening understanding of the precise problems confronting our operational partners, and to the Directorate's increasing capacity to identify and make use of the innovation of others in the private sector, in universities, in the

national labs and around the world. I am honored to lead the DHS S&T Directorate and look forward to your questions.