CRITICAL RESEARCH/INNOVATION FOCUS AREA DOCUMENT

Vehicle-Borne Improvised Explosive Devices (VBIED) Detection

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May 4, 2009
Version 1.0

Please note that as more details are available, DHS will post updated research/innovation focus area overviews on the FutureTECH website. This is a pre-decisional draft document of the NSTC Subcommittee on Domestic IEDs. Please contact Dr. Ruth Doherty, ruth.doherty@dhs.gov for more information.

Who?

Identify any DHS component stakeholders that contain or represent potential end users. Also name any Capstone IPT(refer to http://www.dhs.gov/xres/programs/gc_1234200779149.shtm and the article entitled "Making it Easier to Work with DHS"), if any, which identified a capability gap related to this research/innovation focus area.

The U.S. Department of Homeland Security (DHS) leads for CIEDs are the Office for Bombing Prevention and United States Secret Service (USSS). The corresponding DHS Science and Technology (S&T) Capstone IPT that identified capability gaps related to this focus area is entitled "Counter-IED."

What?

Describe a required technology/capability. Describe how a technology will provide the capabilities and functional improvements needed to address the DHS need. Do not describe a specific technical solution. Instead, describe a conceptual technology for illustrative purposes. Define typical missions that the proposed technology could be utilized to accomplish.

The problem of VBIED detection can be split into two operational categories: 1) checkpoint screening applications wherein the detection system occupies a fixed location and observes all vehicles passing through the checkpoint for evidence of the presence of a VBIED; and 2) mobile or portable applications that may be needed to determine from a distance whether or not a suspicious vehicle is a VBIED. The applicable technologies for these two categories may be the same or different, but the implementation will differ based on operational considerations.

The desired VBIED detection solution:

- Must provide rapid, non-invasive, stand-off explosives detection capabilities across the threat spectrum, in a noisy environment, in sufficient time (minutes if not seconds) for effective action to be taken to neutralize the threat at a sufficient distance to place the operator and target outside of the hazard zone for that category of device. Optimally, it also will identify the location of the explosives within the vehicle.
- For mobile applications, the solution should be compact enough to be transported on a bomb squad response vehicle or trailer, require minimal effort to set-up and operate, and have a small footprint. Ideally, it would be handheld or at least small and light enough to be deployed by a robot or carried and set-up by an individual wearing a bomb suit.
- Should require minimal training to operate and maintain.
- Should be able to quickly screen suspect vehicles without having to scan each side of the vehicle separately.
- Must be able to quickly adjust screening capabilities to accommodate any size vehicle.
- Must not be affected by: the physical condition of the vehicle; emissions that are given off from the subject vehicle or any other vehicles in the vicinity; elements such as water, salt, dirt, sand and other grime that is commonly found on vehicles. It must be able to operate in all environments and weather conditions.
- Must not pose an unacceptable safety risk to the operator, bystanders or occupants of the vehicle being surveyed. Safety considerations both with regard to operation and disposal of nuclear materials would seem to make nuclear-based solutions unsuitable for use by state and local agencies.
- Must be cost effective.

Science and technology (S&T) will support the development and testing of VBIED explosives detection solutions to standards that meet the minimum requirements of end users. Among the key contributions that may be provided by S&T are:

- Development of concepts for rapid and non-intrusive imaging of the contents of a vehicle
- Approaches to stand-off detection of improvised explosive devices (IED) components through electromagnetic signatures or other characteristics of the initiation system
- Development of methods of access that are minimally disruptive and have a low probability of initiating an IED accidentally
- Stand-off methods of detecting explosives residues deposited on the vehicle
- Characterization of the likely distribution and quantity of explosives residues on vehicles bearing IEDs

References:
a. HSPD-19 Requirement 5(d): Improving Capabilities to Combat Terrorist Use of Explosives within the United States.
b. High Priority Technology Needs, June 2008, Science and Technology Directorate, Department of Homeland Security, page 10, Counter-IED.
c. National Strategic Plan for U.S. Bomb Squads, December 2007, National Bomb Squad Commanders' Advisory Board, page 12, Section. 5.1.2.; page 19, Section 7.

Why?

Describe the analysis and rationale for requiring a new technology/capability. Describe why existing technologies cannot meet current or projected requirements. Describe what new technologies/capabilities are needed to address the gap between current capabilities and required capabilities.

All existing solutions to remotely confirm the presence of a VBIED require proximity. No known existing solutions provide the ability to detect a VBIED with any reasonable degree of assurance at a sufficient distance and in sufficient time to allow actions to be taken to safely deal with the threat posed by that device. A sufficient distance depends on the size and nature of the explosive device(s) carried in the vehicle, but can safely be assumed to be on the order of 100s of meters.

Bomb squads rely on visual confirmation with either a bomb technician or preferably a robot in close proximity to a vehicle. Confirmation will often require punching a hole in the vehicle and inserting a probe risking premature detonation and placing the bomb technician in great danger.

There are numerous challenges associated with detecting VBIEDs. One challenge is that there is not a standard type of vehicle associated with VBIEDs. Thus any proposed solution must be applicable to any of the types of vehicles likely to be encountered where the detection system is deployed. Vehicle selection usually depends on several factors: ability of the vehicle to blend in with the normal traffic at the target; vehicle availability; and the security surrounding the intended target.

For instance, "hardened" facilities with good physical security measures (including barriers to ensure significant standoff distances) may require the terrorist to use trucks with large, enclosed

cargo areas. A vehicle of this size provides increased explosives capacities capable of generating damaging air blast effects over a large distance.

Secondly, there are not standard explosives associated with VBIEDs. If the proposed solution focuses on detection of the explosives rather than device components (e.g., wires, batteries and other electronic components), then the explosives detection technologies must be able to detect a spectrum of threats including homemade explosives (HMEs). Additionally, these technologies must possess stand-off detection capabilities in a fast-paced environment with dynamic backgrounds and must be able to achieve low false alarm rates. Furthermore, detection systems cannot be static. They must include the capability to easily upgrade system algorithms to respond to new explosives threats and background conditions as well as threats actively attempting to defeat the system and security measures.

Other challenges in detecting VBIEDs with explosive detection technologies:
1. The reduction of false alarm rates while maintaining detection capability is central to a solution for this need. Insufficient signal to noise on the detector and interference with detection capabilities from frequently carried commodities cause high false alarm rates and have the capability to obscure explosive threats. High false alarm rates can result in operators clearing or ignoring alarms and have the potential to cause major delays to ground transportation.
2. Explosives with low vapor pressures may be particularly difficult to detect depending on the basis of the detection technology.
3. Vehicle checkpoint throughput rates are low and detection technologies are not able to rapidly screen vehicles of various sizes (ranging from cars to trucks).
4. There are difficulties in penetrating various materials/commodities to screen concealment areas in vehicles.
5. Depending upon the technology, passengers may not be able to stay inside the vehicle while it is being screened because of safety concerns. Furthermore, exclusion areas are required for equipment operators, vehicle occupants and the general public; this requires a large operational footprint.
6. Detection technologies tend to be expensive to purchase, operate and maintain.

X-ray imaging systems are much less susceptible to false alarms than explosive detection technologies, but share many of their other limitations including safety and high cost. They also tend to be large and cumbersome.

When?

If a technology/capability is intended as a countermeasure to a threat, summarize the threat to be countered and how the technology could be used (i.e., concept of operations). If applicable, provide a schedule/timeframe to capture when the technology/capability is needed in order to address the DHS gap.

Over the last two decades, terrorists have used VBIED tactics (sometimes in sophisticated simultaneous attacks) to target global suppliers of critical resources and U.S. interests around the world. This tactic has impacted our government's ability to protect its citizens and workers of host nations, provide vital services and has created the potential for using system disruption tactics as a method of strategic warfare. Gauging by the number of casualties and amount of property damage, VBIEDs have been the most successful means of terrorist attack both domestically and internationally, except for the September 11, 2001 attacks. Available intelligence based on global

events and terrorist trends and past experiences, such as the bombing of the Murrah Federal Building, suggests that terrorist networks will most likely use VBIED tactics to attack our homeland. Factors contributing to the popularity of VBIEDs among terrorists are the wide availability of materials used to make IEDs; the ability to conceal large amounts of explosives; the ease of getting the vehicle to the target; the proliferation of bomb-making instructions; and a history of extensive experience and success, which increases repetition and imitation.

Where?

Describe the projected threat environment in which the technology/capability may be potentially deployed.

The solution must be able to operate in all environments and weather conditions.