

DHS S&T First Responders FY18/19 Capability Gaps

On an annual basis, the Department of Homeland Security (DHS) [Science and Technology Directorate](#) (S&T) meets with [first responders](#) to gain critical stakeholder input on capability gaps that serve as a roadmap for S&T's technology scouting, research and development, and transition efforts. The capability gaps or Statements of Objectives (SOO) developed as a result of these meetings help determine how S&T engages with business, industry, innovation and academia partners, and ultimately how S&T provides first responders the tools they need to protect communities and stay safe while performing their duties.

The SOO's form the basis of an annual [Broad Area Announcement \(BAA\) solicitation](#). While the BAA has specific requirements and deadlines for submission of white papers and proposals, the SOO's provide documented [first responder capability gaps](#) S&T can address. While the deadline for the BAA or other S&T funding opportunities may have passed, S&T remains interested in hearing about your organizations capabilities in these areas.

- **Hands-Free Presence-of-Life through Walls Detection, Localization, Alert, and Recording System**

Firefighters and law enforcement spend considerable time searching for people, but often for different purposes. While a firefighter may be trying to find a victim in a burning building, law enforcement officers might be searching an area for a suspect or preparing to breach a room in an active shooter situation. Certain presence-of-life technologies already help firefighters save lives. However, current iterations are deficient for most law enforcement purposes due to burdensome form factors, long measurement times, and inconsistent readings depending on the material the responder is attempting to "see through."

Law enforcement officers require a reliable, hands-free presence-of-life capability that has a quick or constant reading. The solution would be particularly helpful to SWAT teams as they enter or are inside a building in which an armed perpetrator's whereabouts are uncertain. In this situation, officers are vulnerable while turning a corner, breaching a room, or in an area with limited cover. The solution is also likely to be used in instances where officers search for victims of human trafficking or kidnapping in typical hiding areas such as behind false walls in large trucks or apartments. The capability to detect life behind walls, barricades, household objects, and closed doors will undoubtedly enhance an officer's situational awareness. The solution will improve the safety of police officers, provide them with critical information that potentially enables more tactical options, as well as increase the likelihood of them finding human trafficking and kidnapping victims.

- **Real-Time Indoor Visualization System for Low Visibility Fire Environments**

Firefighters are susceptible to disorientation and confusion when entering a structure with low visibility. Impaired vision in a high-stress environment endangers even the most experienced firefighters and decreases their response effectiveness. In areas of heavy smoke, firefighters might struggle to find unconscious victims, assist with the hand line, or have good situational awareness of their immediate environment. Generally, a

firefighter might also be unsure of his or her next step, leading to longer fire suppression times and depleted air supplies. Gloves, self-contained breathing apparatuses (SCBAs), and masks diminish a firefighter's sense of touch, smell, taste, and hearing, but a blinded firefighter is most significantly compromised. It is imperative that firefighters retain visual fidelity.

Firefighters require a solution that visualizes the environment and shares critical information, but not in a distracting manner. The solution must be hands-free, able to operate in high heat and other hostile environments common to those firefighters are exposed to and cannot negatively impact the firefighter's physical behavior. The solution is expected to be integrated with commonly used gear and must not burden the firefighter with unusual or complicated attachments.

- **Gunshot Detection, Localization, Alert, and Recording System**

When a shooting occurs, responders generally rely on a nearby person to call 911 and notify them of the incident. However, witnesses do not always call 911 (especially in areas of extreme gun violence) or information shared with dispatch could be incorrect. Predictive policing is an increasingly popular alternative to stem gun violence but comes with significant policy hurdles. Responders need a simple technology that will alert them to more shooting incidents (near instantaneously), provide critical information ahead of their on-scene arrival (e.g., multiple types of gunshots could suggest there being multiple shooters), and record evidence that is useable in court. These three capabilities would improve the safety and effectiveness of responders to gun violence incidents.

- **Three Dimensional X-Ray**

Currently, bomb technicians do not have a three dimensional (3D) capability to identify potentially harmful contents in a container or space. Although 3D capability exists in the medical community, bomb technicians need a portable system that allows for clear identification of contents within a predetermined object or space. In addition, several obstacles—such as walls, boxes, and barriers—can prevent technicians from quickly identifying a potentially explosive substance and determining the proper course of action. When lives are on the line and every second counts, responders need a clear, concise 3D imaging tool that can give them an instant picture of the threat they are facing.

The technology solution should allow bomb technicians to rapidly generate 3D X-ray images of the inside of a suspicious container or barrier to ascertain precise positioning information about potentially harmful entities, such as improvised explosive devices (IEDs), that may be encased in metal, shielding them from radio-frequency technologies. The proposed solution would then allow for the exported images to be manipulated, via a software package, to create a 3D model of the identified item.

- **Data Upload Mechanism for Sharing Floor Plans and Site Safety Data Easily**

First Responders lack the situational awareness capability to quickly assess the layout of a building upon entry. First responders currently carry binders of printed floor plans with them or respond to incidents blindly with no knowledge of building layouts. In many instances, this prevents them from taking necessary precautions, leaves them without

necessary equipment and tools, and generally leaves them at a situational awareness disadvantage when arriving to a response scene.

First responder subject matter experts identified a need for a mechanism to access digital floor plans and other key safety data (e.g., standpipes, designated evacuation routes, secure facilities, hazardous materials (HAZMAT) locations, and gas or power panel locations). Information provided in advance by building owners and local jurisdictions could be extremely beneficial to the safety and efficiency of responders in the field.

This solution will provide baseline floor plans and site safety information to provide operational context for tracking systems, HAZMAT response, augmented reality and many other first response applications. From an operational perspective, this will allow first responders to be better aware and plan more effective responses to emergency situations.

- **GPS Tracker and Biometric Monitor for Detainees**

The capability to track and monitor detained personnel is limited to visual inspections at federal detention centers. A significant amount of staffing resources go towards the monitoring of detainee location and health. Currently, the primary way to determine the status of detainees is through visual inspection by the facility staff which is periodic and does not reflect real time status.

A device is required that will enable staff to locate and track of all detainees at a facility more efficiently and cost effectively. This technology could potentially reduce staffing needs and improve accountability at federal detainment facilities. The device can be activated at check-in and can also be used during transport between facilities.

- **Hazardous Crowd Dynamics Detection**

First responders lack the integrated technology to track hazardous behavior of individuals/groups during public events. First responder subject matter experts identified a need to detect hazardous behavior by people and crowds in public locations and during major events. Currently, personnel must manually review video streams and other visual data, if available, and typically are not doing so continuously throughout events.

This technology will detect adverse behavior displayed by individuals or groups of people (crowds), including unsafe crowd speeds, density pressures, directions and other high risk behaviors that are synonymous with hazardous situations. In addition, the solution can leverage existing technologies to model safe crowd densities and likely crowd speeds overlapped from density and motion estimates from video analytics. It would need to dynamically account for barricades and security measures.

- **Improve Communications in High Loss Environments**

First responders lack the capability to effectively communicate in all high loss environments. Effective actions in emergency situations require clear and constant lines of communication. It is not uncommon for responders to find themselves in situations where the quality and speed of communication can be significantly impaired. Whether

responders are deployed to limited-access locations (e.g., underground subway tunnel, rural community, areas affected by disasters) or locations where available signals are already strained due to high local demand (e.g., sports stadium), it is critical for them to maintain continuous lines of communication to enhance life safety and efficiency.

This technology will provide cellular and radio amplification to areas of degraded communication to assist first responder activities. This temporary solution will allow responders to work together in areas where they cannot currently communicate and provide the capability for radios to be operable on different channels.

- **Real-Time Electronic Data Sharing**

To more effectively manage emergency response, first responders serving in a leadership capacity need a tool that 1) maps out incident scenarios, 2) provides a visual overview of the location and progress of first responder teams on the ground in response to an incident, and 3) permits digital substitution for paper-based incident command decision-making tools. Additionally, non-leadership personnel, particularly those in the field, do not have the capability to 1) quickly inform higher levels of command during a response besides relaying information by radio or in-person, or 2) passively and continuously share their location, status, or the details of their surroundings. These issues negatively affect most first responder disciplines, particularly in environments with limited visibility, intricate architectures, or complex events. The technical solution shall be applicable to firefighters, Hazardous Materials (HAZMAT) teams, disaster response teams, and certain law enforcement personnel such as special operations units during unusual and complex incidents (e.g., riots). Simply being able to tell which floor a first responder is on in a high-rise, for example, provides invaluable geo-spatial awareness for incident command. A quicker response results in the increased likelihood of lives saved. Also, improved awareness of nearby first responders shall reduce the risk of friendly-fire. This component of the solution is expected to be the next generation precision outdoor and indoor navigation and tracking tool for first responders. However, the technical solution is also expected to provide the capability to electronically document, save, and share back to command center in real time data on incident planning, actions, and mapping.

- **Responder Early Identification**

In various types of emergencies, it would be valuable for responders to automatically be made aware of each other's arrival and location. This would enable them to better coordinate their actions. In order to plan collaborative response activities more safely and effectively, first responder teams need a technology that will track team member locations in real-time. An example of when this would be useful is a situation involving an active shooter or other hostile actor. This technology will help responders to avoid harming each other in error.

This technology shall provide geolocation tracking of responders on the scene during an emergency and notify nearby responders of each other's presence and location. The system shall be easy to activate and use in an emergency situation and be able to incorporate responders from a range of services and levels of government. The system should be secure, and as part of registration users should list their qualifications and have

them verified by their agency. The system should also be able to communicate across various platforms (e.g., web-based, Android OS, iOS).

- **Robotic Stereoscopic System**

Bomb technicians currently have a limited control of stereoscopic cameras mounted on robots to aid in activities related to rendering improvised explosive devices safe. The camera allows technicians to have a clear binocular perspective while performing their functions from a safe standoff distance. However, technicians encounter situations where the functionality of the robotic camera is limited due to the inability of the technicians to operate the camera independently of the robot. Technicians need the ability to operate and generate video feeds to an external display device independent of the robot and its feed.

This technology solution will allow for multiple options for the stereoscopic camera systems to be mounted on various areas of the robot, act independently of the robot (being controlled by the technician and produce independent video feeds) and transmit 1080p, three dimensional (3D) video feeds to a system independent of the robot camera itself. The proposed solution will result in a wider range of capabilities (depth perception) for the robot and increased functionality of the camera system.

- **Video and Sensor Data Reduction**

Filtering out the important data and creating an actionable process is not only an issue on a consumer level, but also in the first responder community. Several information feeds are available to first responders and public safety departments including: video surveillance streams, analytics, geo-alarms and Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) sensors. With the constant influx of information occurring on a daily basis, first responder agencies must determine what information is pertinent to their daily operations and what is not. In addition, this leads to longer response times and the inability to allocate the resources needed to respond to incidents effectively. Agencies need to filter down to mission critical data, which will create meaningful situational awareness (that can be shared), which triggers an actionable response.

This new technology will filter out uninformative video details (through machine interpretation) users classify as “unnecessary.” It will result in smart reduction of both resolution and frame rates (to provide summary views of the video, such as in thumbnail views) as well as entire clip censoring (if “nothing is happening here” on the video stream). Additionally, the technology will use video interpretation and filtering technologies currently on the market or that will be produced (those at a proof of concept stage or in development) in the near future. With the ability to filter out unnecessary visual data, this would substantially reduce the data overload sent to first responder agencies.