Urban Operational Experimentation hosted by the
National Urban Security Technology Laboratory (NUSTL)

FIDO B2
Report

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Executive Summary

Operational experimentation (OpEx) of FIDO B2 was conducted on July 30, 2015 at the New York City Police Department's (NYPD) Floyd Bennet Field Facility in Brooklyn, New York. Participating first responders represented various agencies and jurisdictions, including the Port Authority of New York and New Jersey, NYPD Counter-Terrorism Unit, NYPD Emergency Services Unit, Chicago Fire Department (Illinois), Boston Fire Department (Massachusetts), Montgomery County Fire and Rescue (Maryland), California Governor's Office of Emergency Services and Chesterfield Fire and Emergency Medical Services (Virginia).

FIDO B2 by FLIR, Inc. is a networked, bio-active clarifier bio-aerosol detector that alarms when an airborne bio-threat is detected. It is intended to bridge a technology gap in situational awareness by enhancing the ability to detect, monitor and analyze passive and active threats and hazards at incident scenes in real time.

Participating first responders and observers engaged in an abbreviated training session where representatives from FLIR, Inc. demonstrated the basic functions and features of FIDO B2. Three sensors were set up outdoors, and a laptop that acts as the user interface was located indoors in a classroom trailer. The sensors were then exposed to a non-biological simulant aerosol to trigger the system. First responder participants were able to engage with the user interface to cycle through the different display options, and better understand how and why the alarms triggered and which sensors were triggered.

The OpEx participants believed that FIDO B2 was a simple, ruggedized tool that would be a useful asset for providing security at high profile events, such as sporting events or political visits. First responder participants indicated the technology was useful and promising, but still voiced concerns and questions. Some of their concerns revolved around network security. The user interface and sensors are both two-way transmit/receive communication devices and participants voiced concerns that hacking into these devices could lead to false alarms. FLIR, Inc. stated that they continuously work with their customers to mitigate security concerns and are capable of altering the communication protocols to meet the standards of their customer, if needed. Responder participants were pleased that FIDO B2 allows for sample collection so that further analysis may be conducted at a laboratory for validation of threats. Other concerns they voiced were related to creating a friendlier user-interface and understanding the potential causes of false alarms, specifically in environments such as subway systems.

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1 Introduction

The FIDO B2 Integrated bio-active clarifier (IBAC) by FLIR, Inc. is an automated biological aerosol agent detector. It is meant to increase situational awareness of biological threats by providing a quick and continuous method for detecting biological agents. The system consisted of networked systems that can be deployed both indoors and outdoors. The monitoring of biological levels and alarm triggers is conducted remotely from a laptop.

On July 30, 2015, FIDO B2 was demonstrated during the Department of Homeland Security (DHS) Science and Technology Directorate's (S&T) Urban Operational Experimentation (OpEx) event, hosted by the National Urban Security Technology Laboratory (NUSTL). This event brought together first responders and product developers to experiment with emerging technologies in operational conditions. New York City Fire Department, New York City Emergency Management, New York City Police Department and Port Authority of New York and New Jersey subject matter experts supported the OpEx by selecting the technologies and working with NUSTL scientists to plan the experimentation scenarios and arrange test venues. Responders from these agencies and members of the First Responder Resource Group experimented with the technologies and provided feedback and observations. Table 1 lists all of the technologies that were included in this event. Technologies assessed during this event were selected for their potential to meet capability gaps identified in the Project Responder 4 National Technology Plan for Emergency Response to Catastrophic Incidents (1).

Table 1. Technologies Included in OpEx 2015

Product Name / Manufacturer	**Description**
Situational Head Up Display Avon Protection Systems	Micro liquid crystal display (LCD) display with full color widescreen layout built into face shield
Tridion™-9 PerkinElmer	Portable Gas Chromatography/Mass Spectrometry (GC/MS) system that provides identification of volatile and semi-volatile organic hazards in the field in less than three minutes
BioFlash-E Biological Identifier PathSensors	Portable and rapid aerosol sample collection and identification of up to 16 biological threat agents
FIDO B2 IBAC FLIR	Networked array of portable biosensors
Internet of Things for First Responders BAE Systems	Networked sensors that use a long range wireless protocol capable of concrete penetration to send signals through a network aggregator
Knight Robot/HAZPROBE WM Robots	All-terrain robot with a manipulator arm, cameras, and a boring and inspecting device that can drill through walls for bomb tech personnel to inspect suspect abandoned vehicles or objects
RepKnight ADI Technologies	Monitors and analyzes social media with geolocation feature
X-Ray Scanning Rover Smart Imaging Systems	An x-ray scanner integrated into a custom built robot that is designed to rapidly screen suspicious left-behind bags or parcels on the ground

1.1 Purpose

The purpose of the FIDO B2 operational experimentation was to provide feedback on the prototype technology for first responder use. By bringing together law enforcement, emergency responders and product developers, design changes can be effected early, responders can learn about emerging technologies to enhance mission capabilities, and S&T can gain a better understanding of first responder needs and gaps to guide future homeland security investments.

1.2 Objective

This experimentation allowed responders to observe the use of the FIDO B2 in an operational setting and offer feedback and suggestions to the developers to enhance the product capabilities and usability for responder operations.

1.3 Responder Capability Need

The ability to detect, monitor and analyze passive and active threats and hazards at incident scenes in real time is vital to first responders to properly mitigate and respond to those threats. FIDO B2 is a product that attempts to bridge this gap in the area of biological threat detection.

1.4 Prototype Description

The FIDO B2 IBAC bio-aerosol detector (see Figures 1 and 2) is an automated biological agent detector that alarms in less than 60 seconds when an airborne bio-threat is present. Its IBAC technology uses ultraviolet laser-induced fluorescence to discriminate biological organisms from background particles, and to detect four classes of bio-agents (spores, vegetative cells, viruses and toxins) at concentrations below 100 agent-contaminating particles per liter of air. The particles that enter FIDO are evaluated for reflected fluorescent color, particle size and fluorescent intensity to discriminate between biological threats and other particles in the air. The sensor can continuously monitor the environment for the presence of bio-threats, alarm upon detection, and collect and preserve samples for secondary confirmation and identification analysis on other systems. The field sensors suck in air from the surrounding environment at a rate of 4 liters per minute. The FIDO B2 sensors use two-way communication. The deployed sensors not only relay data from the field, but can also be controlled remotely from the command and control platform.

Figure 1 - FIDO B2 IBAC Bio-aerosol Detector

FIDO B2 can be used to support a variety of applications, from tactical missions such as special event monitoring and emergency response, to longer-term, fixed installation facility protection. The sensor operates independently, but as part of a network configuration to form the “first tier” of a bio-monitoring system.

Figure 2 - FIDO B2 IBAC Bio-aerosol Detector Parts and Componenets

2 Experimentation Design

A detailed description of the experimentation design can be found in the Experimentation Plan FIDO B2 (2). The experimentation scenarios were developed with input from responders, FLIR, Inc. engineers and DHS NUSTL test scientists to simulate real events and incidents that would demonstrate FIDO B2's capabilities.

2.1 Event Design

This experimentation convened a group of first responders with various backgrounds (counter-terrorism, fire and rescue, emergency management) to experiment with this technology in a simulated operational setting and provide feedback. A FLIR, Inc. representative provided a brief training session and demonstration to familiarize the first responders with how the system worked. First responders were then asked to approach the laptop that acted as the command and control unit for the FIDO B2 software and interact with the software, while three different detection sensors located outdoors were triggered at various intervals.

2.2 Summary of OpEx

On July 30, 2015, 10 responders convened at the New York Police Department's (NYPD) Floyd Bennet Field facility, located in Brooklyn, New York, to participate in the OpEx of FIDO B2. The exercise included representatives from the NYPD Counter-Terrorism Unit and Emergency Services Unit, the Port Authority of New York and New Jersey Police (PANYNJ), Montgomery County Fire and Rescue (Maryland), California Governor's Office of Emergency Services and the Boston Fire Department (Massachusetts). The training, demonstration and all experimentation activities occurred in a classroom trailer on the facility. The FIDO B2 sensors were placed outdoors near the trailer.

The NUSTL experimentation director provided participants with information on the OpEx program's goals, purpose and an overview of the FIDO B2 experiment. A representative from FLIR, Inc. introduced the software application and presented some background information on how it has been used by other organizations. The FLIR, Inc. representative provided a short training session to show users how to physically operate the remote sensors and toggle through the various features of the accompanying software. Several first responders rotated turns in using the command and control software, while a FLIR, Inc. representative used a bioluminescent aerosol as a simulant to trigger the alarms of the three sensors that were set up outdoors. This allowed first responder participants to interact with the system both before and after an alarm was triggered, providing an understanding of the changes that occurred and the information that was displayed when the system alarmed to the presence of a biological threat.

Every participant was given an opportunity to interact with the command and control software (i.e., toggle through different displays and menu options) of the device and watch it alarm. After completion of all activities, the experimentation director led the participants in a discussion to solicit feedback about FIDO B2.

3 Results

All recorded questions and comments are captured in Table A-1 in Appendix A. Feedback and recommendations are discussed below.

3.1 Operational Scenario and Debriefing Comments

First responder participants varied in background, experience and jurisdiction, and this diversity was apparent in the range of feedback.

The first responders' general response and impression to FIDO B2 was positive. Many saw utility in using a system like this to provide added situational awareness and security to high profile events such as sporting events and political visits. There were many questions about how IBAC technology works and how this may affect the potential concept of operations for its use.

Members of the NYPD and PANYNJ wanted to better understand how the system's design and constraints might impact its function in underground environments such as tunnels and subways. FLIR, Inc. stated that these environments tend to have more particulates and dirt, and thus certain maintenance procedures, such as cleaning the optics, would have to occur more frequently. FIDO B2, being a networked device, would also face communications challenges in these environments. First responders were aware of these challenges as they face them in other aspects of their work, and briefly discussed options already available to them such as the use of signal repeaters.

Conversation during the experimentation briefly shifted towards information security and encryption. Noting that the system operated wirelessly, some first responders found it troubling that the system could be hacked or spoofed to provide end users with false information. It was suggested that a "red team" study be conducted to fully understand its susceptibility. The FIDO B2 model that was demonstrated at the OpEx event used a technique known as Frequency-Hopping spread spectrum. This method rapidly switches the frequency of communication in a pseudorandom sequence that is known to both the transmitter and receiver devices. In conjunction with this frequency hopping, information is encrypted using the 128 bit Advanced Encryption Standard. If the system is relying on standard 802.11 Wi-Fi to communicate, then communication is encrypted using the Wi-Fi Protected Access 2 (WPA2) security protocol.

First responders were also very interested in false alarms and how they occur. In their experience, certain detection equipment can become disadvantageous if false alarm rates are high. Understanding under what circumstances a false alarm can occur will influence the situations in which a system like FIDO B2 might be used or even if it should be purchased. FLIR, Inc. disclosed that certain detergents have been known to cause false alarms, and thus using the device in the vicinity of an area that is being power-washed or cleaned could trigger the device.

First responders felt that the graphical user interface of the command console was sufficient, but still needed improvement in certain areas (i.e., displaying an alarm) and could be optimized to better understand the information being displayed. FLIR, Inc. did state that they are already modifying aspects

of the software, such as how it visually indicates a triggered alarm. First responders were pleased to learn that they were not forced to use the proprietary command console, but could opt to have the requisite information ported into a command console software of their own preference or choosing.

The first responder participants determined that this device is a useful tool in the first line of detection for biological threats. It provides a rapid result that can be further explored by more sensitive and reliable lab equipment.

4 References

1. **U.S. Department of Homeland Security.** *Project Responder 4 - 2014 National Technology Plan for Emergency Response to Catastrophic Incidents.* s.l. : DHS Science and Technology, July 2014.

2. **NUSTL.** *Urban Operational Experimentation Plan FIDO B2 Biological Detector and Collector.* New York City : Department of Homeland Security Science and Technology Directorate, July 2015. OpEx-T-PL-8.

5 Acronym List

DHS	-	Department of Homeland Security
IBAC	-	Integrated bio-active clarifier
NUSTL	-	National Urban Security Technology Laboratory
NYPD	-	New York City Police Department
OpEx	-	Operational Experimentation
PANYNJ	-	Port Authority of New York and New Jersey
S&T	-	Science and Technology Directorate

Appendix A

Table A-1. Questions and Comments, Grouped by Topic

Topic	Comment

Detection Methods & Alarming	• Is it a point detector?
	  o Yes, each sensor acts as a single point detector. They are networked though, and could provide information to a command and console interface.
	• Does FLIR, Inc. make a mobile standoff biological detector?
	  o A: No, but FLIR, Inc. has also tested putting this technology on an Unmanned Aerial Vehicles (see Table A-2).
	• Why is the air throughput low (4 liters per minute)?
	  o FIDO is intended as a point sensor for constant air monitoring and low airflow is sufficient for continuous monitoring operations. When an alarm is triggered, the air throughput is increased for collection purposes.
	• Can pollen cause FIDO B2 to alarm?
	  o Typically no, pollen particles are larger than biological threat agents and particle size is used as a discriminator by the system.
	• Are there non-biological materials that look like biological material? Or other things that cause false/nuisance alarms?
	  o Yes. One example is a component of detergents (pressure washing a subway platform as an example). But intentional release of agents would be expected to produce particles less than one micron. Vigorous skin scratching near a detector could also trigger an alarm. In an outdoor environment, heavy construction with plaster or drywall dust could cause an alarm.
	• How often does FIDO trigger a false alarm?
	  o Depends on the thresholds (which can be set). According to the vendor, prior experience tends to indicate about one false alarm per month per sensor.

Wireless Communication	• Is the communication between the sensors and command console two-way or one-way?
	  o Communication is two way between the command console and the deployed sensors. The sensors can be remotely turned on and off. During the OpEx event, FIDO used a secure frequency at 900 MHz; it can also operate on standard Wi-Fi frequencies of 2.4 and 5.0 GHz. The vendor states they can set up the wireless system or FIDO can be set up to use the responder agencies network or communications frequencies.
	• Is the data encrypted?
	  o Currently FIDO uses standard Wi-Fi protection access protocols associated with Wi-Fi communication.
	• Responders expressed concern that Wi-Fi can be hacked, and the device could be taken over or results spoofed.

Prior Use and Field Testing	• How long has the device been around?

Topic	Comment
	○ IBAC technology has been in use for eight years; however, the FIDO model evaluated here is only one year old. • What kind of previous testing has been done? ○ See Table A-2.
Software/Command Console	• FLIR, Inc. noted that many customer agencies prefer to use their own command and control software and the FIDO is able to port its data into other command and control applications to accommodate this preference. • It was suggested that the software user interface be adjusted such that when an alarm is triggered the visual indicator be more attention grabbing. The sensor read out should flash red. • It was suggested that a column be added that allows user to add remarks, notes and annotations. • Responders would like to see the software take better advantage of the sensors' GPS capabilities to provide a more graphical user interface that can help provide basic plume tracking. • Can the system integrate with graphical information systems? ○ Vendor stated yes, it can.
Cost, Consumables, Maintenance & Other	• The approximate cost is $20,000 per detector. • Responders noted that an agency would want three to five units for monitoring an event, and noted that some jurisdictions would only be able to use it if their local civil support team can supply it due to financial constraints. • What is the detector life expectancy? ○ The parts most likely to fail are the laser and the pump. With continuous running, five years could be a minimum life expectancy. • What are the consumable components and what are their costs? ○ There are no daily consumables. When a secondary collection is triggered by the detector, air is sucked through small, easily removed/replaced filters that cost less than a dollar each. These consumables can be placed into other biological identification systems for further analysis. • Are the consumable filters self-contained? ○ No, they need to be placed in a bag for transfer. • What are additional concerns and considerations for dirty environments like subways and tunnels? ○ The optics can get dirty and would need to be cleaned more often, approximately every six months.

Table A-2. Previous Tests and Demonstrations

Government Agency	Testing Center	Report Title	Report Date
U.S. ARMY RDECOM Joint Project Manager - Biological Defense	National Assessment Group CBR Technology Evaluation Branch	Technology Readiness Evaluation - IBAC Detector	December 2008
Marine Corps Systems Command	Battelle Institute CBRN Information Analysis Center	EBD ATD ARCA BSL-2 DETECTOR TESTING, PHASE II Final Report	May 2008
U.S. Department of Homeland Security Science and Technology Directorate	MIT - Lincoln Laboratory	Subway Biological Detection System Demonstration	January 2014
*FLIR, Inc.	Dugway Proving Ground	DPG Field Test, FLIR Summary 2013 July	July 2013

*FLIR, Inc. sponsored this test; however, it was carried out by Dugway Proving grounds, a U.S. Army facility.