NEXT GENERATION FIRST RESPONDER
CASE STUDY
PATIENT MONITORING

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EXECUTIVE SUMMARY

The Department of Homeland Security (DHS) Science and Technology Directorate (S&T) launched the Next Generation First Responder (NGFR) Apex program to help tomorrow's first responder become better protected, connected and fully aware. DHS S&T has held a series of NGFR Integration Demonstrations to incrementally test and evaluate interoperable technologies currently in development. These demonstrations have evolved from tabletop integrations to field exercises with partner public safety agencies and have involved increasingly complex technology integration.

DHS S&T partnered with Harris County, Texas, and the City of Houston to host the first major urban NGFR Integration Demonstration in December 2018. The NGFR – Harris County Operational Experimentation (OpEx) involved testing a variety of integrated technologies in an operational environment with participating first responders from Harris County, City of Houston, U.S Coast Guard (USCG), SouthEast Texas Regional Advisory Council, Cy-Fair Volunteer Fire Department and the Atascocita Fire Department.

During the OpEx, Harris County, Houston-area responders and federal partners used integrated responder technologies to enhance their mission capabilities in a hazardous materials (HAZMAT) scenario that included a simulated gas leak from a USCG Cutter (USCGC) vessel in the Port of Houston. Together, responders and DHS S&T evaluated how DHS-funded and commercial technologies integrated with existing public safety systems using open standards and how those integrated capabilities enhanced emergency communications, increased operational coordination, improved responder safety and augmented situational awareness.

The NGFR – Harris County OpEx included 23 different DHS and industry-provided technologies, including six Internet of Things (IoT) sensors, five situational awareness applications and platforms, and live-stream video feeds. Additional OpEx technologies included body-worn cameras, deployable communications systems, and real-time data aggregation and access across multiple agencies.

This case study identifies and explains the patient monitoring technologies that were used in the OpEx and discusses how nationwide public safety agencies could implement physiological sensors to improve emergency medical effectiveness, particularly during mass casualty incidents.

DHS S&T's technical team, DHS-funded and industry partners provided the sensors and integration work to support the OpEx, incorporating the feeds from multiple sensors to multiple situational awareness applications. The OpEx scenario provided sufficient realistic opportunities to assess the technologies and allowed participating responders to identify gaps and required enhancements to improve the participating technologies.

Figure 1. Participants Conduct Simulated Emergency Response Activities During the NGFR - Harris County OpEx

DHS S&T and partners brought new sensor capabilities to Houston-area responders. By integrating data from multiple sensor types—including real-time triage sensors monitoring patient vital signs—into unified situational awareness applications, the NGFR Apex program enhanced operational communications, increased operational coordination, improved responder safety and augmented situational awareness. The OpEx demonstrated that the first responders, incident commanders and emergency managers were able to access real-time sensor information and alerts during the scenario by interacting with the various situational awareness platforms provided for the OpEx.

Administrative and Handling Instructions

The title of this document is the "Next Generation First Responder Case Study: Patient Monitoring." This document provides public safety agencies with an overview of how DHS S&T incorporated physiological sensors for patient care during the NGFR – Harris County OpEx and provides some areas that an agency may consider if they choose to implement the capability within their organization. All preparation and documentation for the NGFR – Harris County OpEx is unclassified.

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If you have any questions about this case study, or to request more information about the NGFR – Harris County OpEx, please contact NGFR@hq.dhs.gov. Public release of information is at the discretion of DHS S&T.

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INTRODUCTION

Next Generation First Responder Apex Program

The Department of Homeland Security (DHS) Science and Technology Directorate (S&T) works with America's first responders to ensure they are more effective and safer—regardless of the hazards they face. DHS S&T develops and adapts innovative technologies that help first responders make communities more secure and resilient, because homeland security truly starts with hometown security.

The Next Generation First Responder (NGFR) Apex program is a five-year program that began in January 2015 and is part of a longer-term DHS S&T commitment to envision and assist the responder of the future. The NGFR Apex program works to make responders better protected, connected and fully aware by developing, adopting and integrating cutting-edge first responder technologies using open standards. This complex, multi-disciplinary program consists of a diverse but related portfolio of projects that span from basic research to advanced technology development, and an initiative to define a common set of open standards for technology integration. These open standards enable industry partners to develop standards-based solutions that easily plug-and-play into an interoperable responder ecosystem, including legacy systems. This approach opens doors to industry while lowering costs and increasing choices for public safety organizations, helping them rapidly adapt to changing environments and evolving threats as they secure communities nationwide.

NGFR Integration Demonstrations

Since 2016, DHS S&T has held a series of NGFR Integration Demonstrations to incrementally test and evaluate interoperable technologies currently in development. These demonstrations have evolved from tabletop integrations to field exercises with partner public safety agencies, including the rural 2017 Grant County—DHS S&T NGFR Apex Program Technology Experiment. This case study highlights the efforts, lessons-learned and guidance from the NGFR – Harris County Operational Experimentation (OpEx) that was held in December 2018 in Houston, Texas, to demonstrate the interoperability of DHS S&T and industry-developed responder technology and increase community resilience.

DHS S&T has incorporated the results and responder feedback from the NGFR Integration Demonstrations into the NGFR Integration Handbook, which outlines a standards-based environment that enables commercially-developed technologies to integrate with existing first responder infrastructure. Using the lessons learned and responder feedback from these integration demonstrations, DHS S&T has also produced materials to help public safety agencies implement new technologies that address their operational priorities, such as the NGFR Case Study series, which this document is part of.

NGFR Operational Experimentation in Harris County, Texas

DHS S&T collaborated with public safety agencies from Harris County and the Houston area to host the NGFR – Harris County OpEx from December 4-5, 2018, at the Port of Houston. Participating agencies included Harris County (Fire Marshal's Office, Sheriff's Office Marine Unit, Office of Homeland Security and Emergency Management, Central Technology Services, and Community Emergency Response Team), the City of Houston (Fire Department, Police Department Marine Unit, and Information Technology Services), Port of Houston Authority (Emergency Management, Fire Department, Police Department), SouthEast Texas Regional Advisory Council, Cy-Fair Volunteer Fire Department,

Atascocita Fire Department, U.S. Coast Guard Sector Houston-Galveston, DHS Federal Emergency Management Agency's Integrated Public Alert and Warning System Office, and DHS Cybersecurity and Infrastructure Security Agency's Emergency Communications Division.

The goal of this OpEx was to integrate and demonstrate a variety of cutting-edge responder technologies, assist Houston-area response organizations in incorporating them into their daily operations, gather responder feedback to help improve both individual DHS-funded and industry technologies, and demonstrate the value of the NGFR Apex program. During the OpEx, Houston-area responders and federal partners used integrated responder technologies to enhance their mission capabilities in a HAZMAT and mass casualty incident response scenario in the Houston Ship Channel. Together, responders and DHS S&T evaluated how selected S&T-developed and commercial technologies integrated with existing public safety systems using open standards and how those integrated capabilities enhanced emergency communications, increased operational coordination, improved responder safety and augmented situational awareness.

Purpose of this Case Study

This case study describes how DHS S&T integrated and deployed physiological sensors for patient triage during the NGFR – Harris County OpEx, taking real-time sensor data and displaying it on unified situational awareness applications to give the Incident Commander, command staff and first responders the right information at the right time. It provides an overview of the systems used, the challenges encountered and the solution implemented for the OpEx, as well as considerations that any public safety agency should think through if they intend to implement patient monitoring for their organization.

OpEx OVERVIEW

OpEx Objectives

DHS S&T hosted the OpEx to validate and advance the Next Generation First Responder Apex program, as well as benefit Houston-area public safety and technology provider partners. The OpEx integrated NGFR technologies to support an operationally-relevant, mission-based scenario centered on HAZMAT and mass casualty response operations. The goal of this OpEx was to demonstrate the capabilities of new technologies and provide a proof of concept to participating responders to illustrate how the technologies could be incorporated into daily operations and existing systems. By gathering feedback from first responders on the technologies and how they did or did not augment public safety emergency response capabilities, the NGFR Apex program seeks to better ensure new technologies fully meet responder needs.

Figure 2. Atascocita and Cy-Fair Paramedics connect physiological sensors to an OpEx "patient" prior to transport

OpEx Requirements

Initial discussions with Harris County resulted in the identification of the following technology requirements for the OpEx:

- Geo-location of first responder personnel in three dimensions on map displays provided to the Incident Commander, the command staff and on smartphones carried by responders.

- Capability to monitor patients' physiological condition and send the data wirelessly to the Incident Commander and command staff for viewing using a visual "dashboard" on a monitor and/or smartphone.
- Remote monitoring of HAZMAT using body-worn gas sensors transmitting alerts to the Incident Commander and command staff.
- Integration of all sensor feeds into one data feed provided to multiple situational awareness applications, especially the two existing applications in place or planned for use by Harris County and the Port of Houston (Intrepid Response and AVERT C2, respectively).

DHS Core Capabilities Alignment

The NGFR – Harris County OpEx was shaped around critical requirements identified by operational partners from Harris County, the City of Houston, Port of Houston Authority, U.S. Coast Guard, SouthEast Texas Regional Advisory Council, Cy-Fair Volunteer Fire Department and Atascocita Fire Department. These requirements included helping fill gaps identified during the response to Hurricane Harvey in 2017, particularly gaps around information sharing and multi-jurisdictional coordination. The planning process included joint identification of OpEx objectives and targeted DHS Core Capabilities, which included:

- Operational Communications;
- Operational Coordination;
- Environmental Response/Health and Safety;
- Intelligence and Information Sharing;
- Access Control and Identity Verification;
- Mass Search and Rescue Operations;
- On Scene Security, Protection and Law Enforcement;
- First Responder Safety; and
- Situational Awareness.

OpEx technologies were selected to meet these Core Capabilities and the scenario was developed to test the technologies and the associated operational capabilities.

Figure 3. A DHS Data Collector Observes the Harris County HAZMAT Team During the OpEx

OpEx Scenario

The OpEx scenario provided sufficient realistic opportunities to assess the various technologies' utility and integration with existing systems (technical and human). The scenario also provided opportunities for participating first responders to identify gaps and required enhancements to improve the participating technologies. The evaluation team was able to verify that the NGFR system architecture implemented and configured at the Port of Houston was easy to install, easy to use and provided capabilities that were valued by the first responders.

The NGFR – Harris County OpEx consisted of an operational scenario divided into three vignettes:

- **Vignette A**: A HAZMAT spill occurs on USCGC Hatchet and the resulting gas cloud also affects the civilian vessel, the M/V Sam Houston, following in its wake. The vessels moor across Buffalo Bayou and HAZMAT teams are activated from the Port of Houston, Harris County, and the City of Houston, as well as EMS units from the City of Houston, Atascocita Fire Department and the Cy-Fair Volunteer Fire Department. Harris County and the City of Houston marine units respond, as well as the Port of Houston Fireboat 1 and a USCG Response Boat Small (RB-S). All HAZMAT

and marine units arrive on scene at the Sam Houston Pavilion and the Battalion Chief from the Port of Houston establishes Incident Command to evaluate the situation.

- **Vignette B**: The Harris County HAZMAT crew sets up a decontamination station at the Sam Houston pavilion, boards the M/V Sam Houston, and starts evaluating the passengers and crew. HAZMAT crews from the Port of Houston and City of Houston board Fireboat 1 and are transported across the bayou to USCGC Hatchet. They board the vessel to evaluate the crew and identify the source and nature of the HAZMAT spill. They also note that one of the crewmembers is unaccounted and is assumed to have fallen overboard prior to mooring.
- **Vignette C**: Victims from civilian vessel M/V Sam Houston undergo technical decontamination, triage and treatment, and are prepared for transport. Victims from USCGC Hatchet undergo gross decontamination and are then transported by Fireboat 1 over to the pavilion, where they undergo technical decontamination, triage and treatment. The USCG crew and a helicopter search for and find the missing crewman in the bayou, the RB-S crew retrieves him and returns him to the pavilion for decontamination, triage and treatment.

OpEx Technologies

DHS S&T worked with federal, industry and on-contract performers to provide 23 technologies, many of which were integrated to increase information sharing and situational awareness during the OpEx. DHS S&T and partners used data and alert standards to facilitate technology integration, including the Sensor Things server running their Open Geospatial Consortium (OGC) standard Application Program Interface (API), and Message Queuing Telemetry Transport (MQTT). Full descriptions of all OpEx technologies are available in the NGFR – Harris County OpEx Playbook and After Action Report listed in the References and Recommended Reading section. Note that the following descriptions were current as of the NGFR – Harris County OpEx in December 2018, and that throughout this document, technologies are frequently referred to by the name of the company rather than the name of the technology. OpEx technologies relevant to this case study include:

ARES Security Corp.

AVERT C2

AVERT C2 is an intelligent command and control platform that provides collaborative situational awareness by allowing each user to view and share the information sources and layers they need to understand and manage events as they unfold. AVERT C2 ingests and visualizes data from virtually any sensor—including chemical sensors, biometric sensors, cameras, radar, access control and alarm systems—to manage all security and response information through a single user interface.

Intrepid Networks, LLC

Intrepid Response

Intrepid Response is a mobile application that enables enhanced situational awareness by providing live responder locations and static locations of interest with a simple user interface. Open API architecture provides integration capability for higher level command and control tools or other platforms.

Pacific Northwest National Laboratory (PNNL)

VitalTag

VitalTag is a small, disposable suite of sensors that securely detects and communicates vital sign data in real-time to first responders. VitalTag measures vital signs including systolic blood pressure, heart rate, shock index, arterial oxygen, electrocardiogram (single lead) and respiration rate. This information helps

first responders more effectively triage, treat and transmit patients during a mass casualty event. PNNL was funded by DHS S&T for this technology.

SensorUp, Inc.

SensorThings

SensorUp provides the Internet of Things platform for customers who rely on geospatial in their IoT Implementations. SensorUp helps make sense of data, combining all different sensors into one easily-managed visualizer and get the bigger picture. SensorThings technology rapidly aggregates and coordinates disparate sensors and IoT systems transforming them into actionable insights. SensorThings provides the primary sensor integration platform for the OpEx by connecting and aggregating various sensors and providing that actionable information to situational awareness tools. SensorUp, Inc. was funded by DHS S&T through a subcontract for this technology.

OpEx Constraints and Limitations

The identified constraints and limitations for the OpEx event include:

- Most of the technology providers were identified through a Request for Information process and worked under Cooperative Research and Development Agreements (CRADAs) with DHS S&T, which did not include funding. This constrained the scope of their participation.
- DHS S&T could not interface with existing Computer Aided Dispatch (CAD) systems for the City of Houston, Port of Houston or Harris County, so the sensor feeds had to be aggregated, normalized and sent to situational awareness applications entirely outside of the local CAD systems.
- The primary situational awareness solutions used—AVERT C2, Intrepid Response and Constellation—were selected because they were already in use (or planned for use) by Harris County and the Port of Houston.

OpEx Communications Architecture

Based upon site visits, a baseline technology assessment of all participating agencies and ongoing collaboration with Harris County and other participants, DHS S&T developed a notional communications architecture. This established the foundation for the OpEx architecture, as well as ensured consistency with the expectations and needs of participating public safety organizations, as shown in Figure 4.

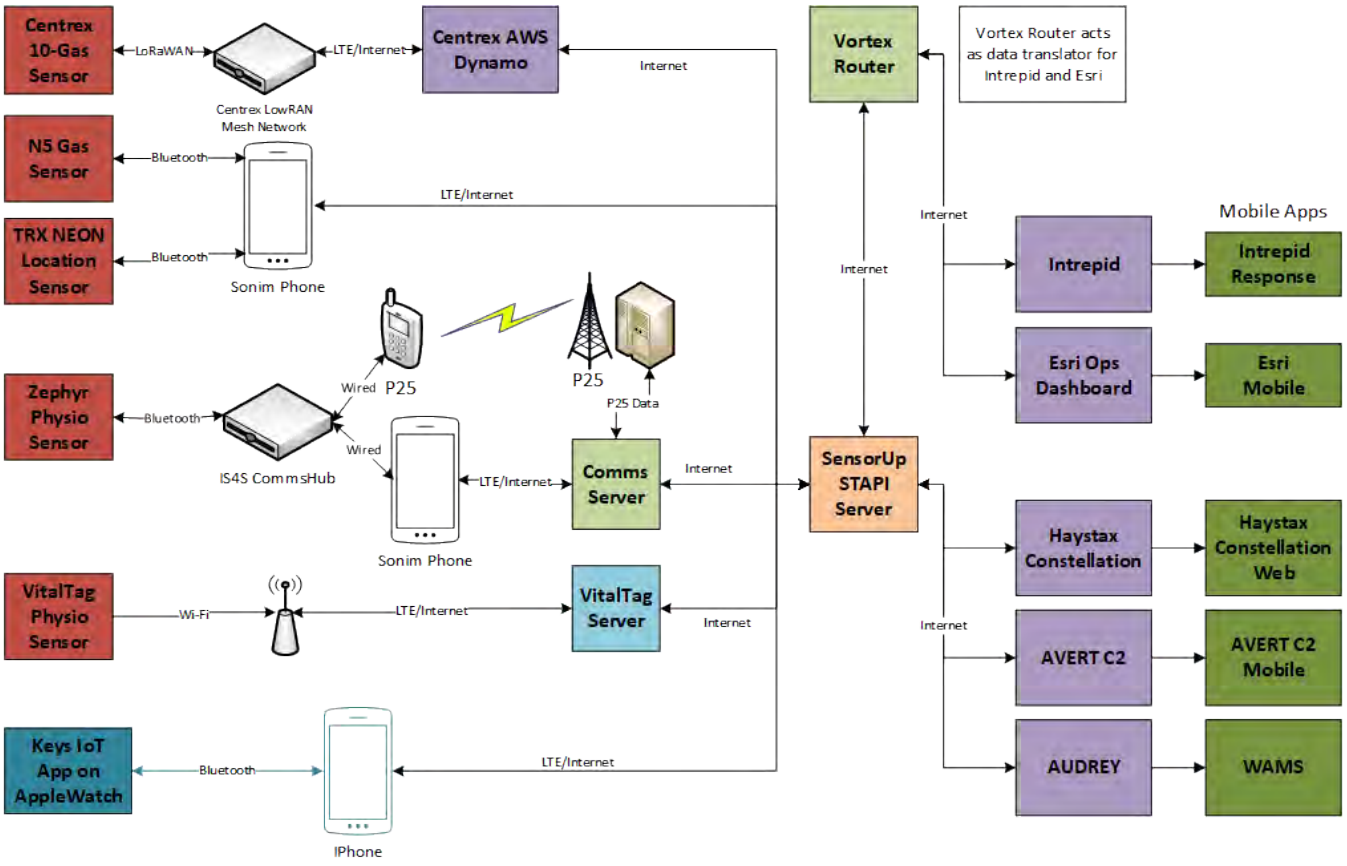

Figure 4. OpEx Communications Architecture with Central SensorUp Data Integration Point

Implementing Patient Monitoring Solutions

It is crucial for public safety agencies, specifically emergency medical services (EMS), to maintain effective real-time awareness of patient status during a response to a Mass Casualty Incident (MCI). Patient monitoring sensors can provide the exact location of each patient, their physical condition and real-time vital signs, their triage tag designation (green, yellow, red, black), and alerts to changes in status. Physiological monitoring of patients in the triage, treatment and transport area of an MCI response allows EMS personnel to make informed decisions that improve patient outcomes while better prioritizing the overwhelmed resources available.

Patient Monitoring Requirements

In order to effectively develop and implement patient monitoring for emergency medical care, NGFR and Harris County assessed their requirements for physiological monitoring of patients and arrived at the following requirements:

- The patient monitoring sensor data shall be integrated with the existing situational awareness platforms through wireless connectivity to a responder's controller, smartphone or tablet, including AVERT C2 (Port of Houston) and Intrepid Response (Harris County);
- The patient monitoring sensors will measure and display the following vital signs:
  - Systolic blood pressure,
  - Heart rate,
  - Shock index,
  - Arterial oxygen,

- Electrocardiogram – single lead, and
- Respiration rate;

- The patient monitoring sensor system shall display all patient locations and include the ability to separate/filter patient groups;
- The patient monitoring system shall send any alerts for sensor readings that exceed configurable parameters to all situational awareness platforms; and
- The patient monitoring on-body device should be low-cost (under $50 each), be disposable and have a battery life of at least three hours.

Baseline Assessment of Existing Capabilities

Participating public safety agencies did not have any wireless sensors deployed nor an environment capable of passing sensor data on to their situational awareness applications without development. Neither Harris County nor the Port of Houston had the capability of a physio sensor to monitor patients or to push alerts to a situational platform in their current environment. There was one nearby agency, Atascocita, which did have a patient monitoring solution providing patient vital sign display to the attending EMT while also transmitting it to the destination hospital. However, the solution they were using was expensive, so the agency could only afford to have one or two on each ambulance and would therefore not be applicable in a mass casualty incident.

OpEx Patient Montoring Sensors

The prototype patient monitoring solution deployed during the OpEx was VitalTag, provided by PNNL. DHS S&T funded PNNL to develop a disposable patient monitoring device, and the resulting product is VitalTag. VitalTag is a lightweight, low-cost, disposable solution for monitoring emergency medical patients prior to hospital care, and particularly during MCIs.

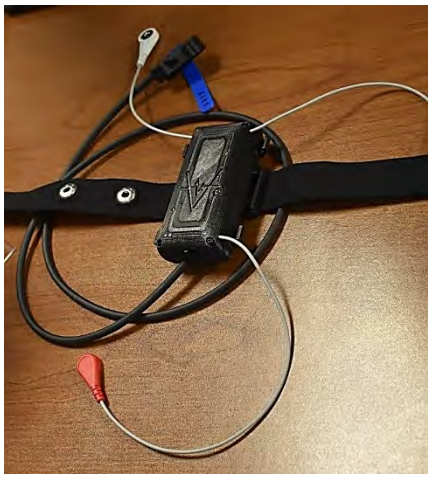

Figure 5. VitalTag Physiological Sensor

During the OpEx, VitalTag sensors—pictured in Figure 5—were strapped to the HAZMAT-contaminated patients that were evacuated from the USCGC Hatchet and the M/V Sam Houston. The VitalTag suite connects to a patient's chest with other sensors attached to the ear and index finger. VitalTag measures vital signs including:

- systolic blood pressure,
- heart rate,
- shock index,
- arterial oxygen,
- electrocardiogram (single lead), and
- respiration rate.

The device then collects and transmits the data via Wi-Fi to both the VitalTag dashboard and other OpEx situational awareness platforms on the EMS team's mobile devices, allowing the team to prioritize their attention to those in need of the most urgent care at the triage site. Patients were assigned stoplight colors to indicate their triage status (green is minor, yellow is delayed and red is immediate) to the EMTs as they monitored the triage area.

DHS S&T worked with developers from Intrepid Response, AVERT C2 and SensorUp (providing data aggregation services) to allow display of the VitalTag sensor data on the corresponding situational awareness applications. In addition, PNNL provided a dashboard—the LifeLink App—for display of the patient data and to be used by the EMTs in the field. DHS S&T was able to integrate the sensor information

from the VitalTags and display on multiple situational awareness platforms for the Incident Commander and EOC. A screenshot of the LifeLink App dashboard is shown in Figure 6.

Please note: due to legal, HIPAA and FDA limitations, the VitalTags used in the NGFR – Harris County OpEx replayed a file of simulated patient data instead of collecting and transmitting live patient data. Because of these limitations, DHS S&T did not evaluate the accuracy of data VitalTag produced, but rather evaluated the use of the sensor in the operational scenario including ease of use and workload considerations.

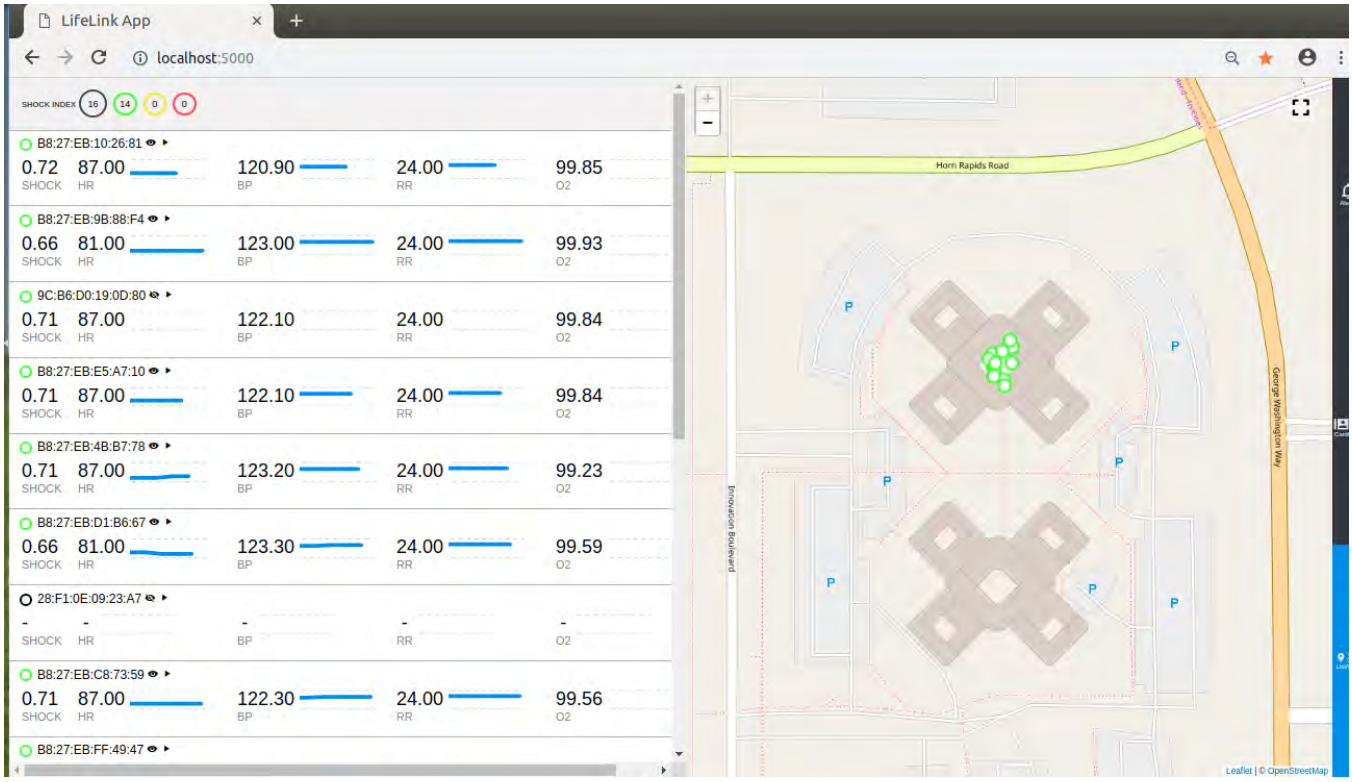

Figure 6. PNNL's VitalTag Dashboard with Simulated Data

VitalTag was based upon a Raspberry Pi Zero single-board computer housed in a plastic case with a battery and sensor leads. At the time of the OpEx, VitalTags had approximately 90 minutes of battery life and included GPS receivers to track patient location. Because of the short battery life and the slow pace of the OpEx, VitalTags were not activated until they were "applied" to the patients. This meant that the GPS functionality, which took about ten minutes to determine initial location, did not provide accurate location data for the first ten minutes or so. In addition, it was noted that the location information did not update frequently enough to provide accurate and timely location data for EMS personnel to use in locating personnel and matching them to the readings on the dashboard. In subsequent discussions with participating EMTs, they indicated that GPS location of victims at a mass casualty was not as important as would be the capability to assign a location (e.g., NW side of building, front of vehicle) to each patient instead of having a GPS location on a map.

The EMTs were pleased to be able to monitor the vital signs of their triage patients on the iPad DHS S&T provided for their use. They held discussions with the PNNL staff and provided feedback to the dashboard developer on the first day of the OpEx. The developer modified the VitalTag dashboard accordingly and the new version was used for the second day of the OpEx. The EMTs were able to track the patients as they were evacuated from USCGC Hatchet, across the bayou and into the triage area, but once the patients were in triage the location information was unnecessary.

Implementation Limitations to Consider

It is important for an agency to understand the policies in place and ensure the patient monitoring sensor data collection system can meet the agency's data security requirements. Agencies should also consider FOIA requirements, privacy needs, HIPAA restrictions, union requirements, evidentiary standards and data storage requirements.

OpEx RESULTS

The OpEx successfully demonstrated both the advantages of the VitalTag patient monitoring sensors and their shortfalls as currently implemented. All of the requirements were fulfilled with the delivered capabilities, but with varying degrees of success. The feedback from participating first responders was overwhelmingly favorable. The EMS personnel and Incident Commander were very pleased to be able to monitor the triage patient's vital signs, although they would have preferred to use live sensor data rather than simulated data during the OpEx. As mentioned, the EMTs considered the location data to be less important when managing a triage area.

Additional information can be found in sources listed in the References and Recommended Reading section. A complete Harris County OpEx After Action Report is under development and will be posted at www.dhs.gov/NGFR and available upon request from NGFR@hq.dhs.gov.

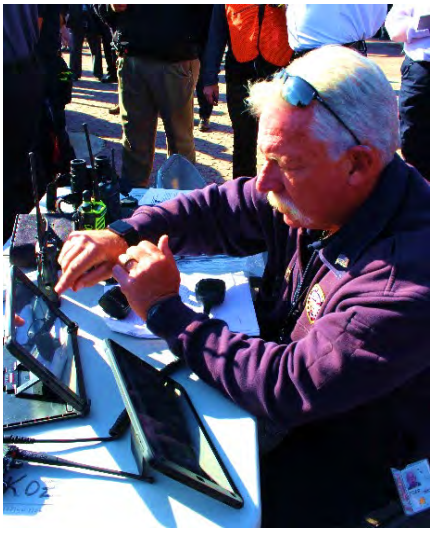

Figure 7. Port of Houston Fire Command Staff Views a Dashboard

IMPLEMENTATION FOR YOUR AGENCY

During the NGFR – Harris County OpEx, DHS S&T integrated patient monitoring sensors with situational awareness platforms to enable public safety decision makers to operate with real-time triage information. How can your agency apply this case study and best practices to improve your capabilities? DHS S&T has developed the following questions to help your agency and/or all of the public safety agencies in your community determine patient monitoring requirements, current capabilities, target capabilities and implementation considerations.

One of the most important features of the NGFR – Harris County OpEx was getting the sensor data for responders from different agencies and jurisdictions integrated into a unified situational awareness platform. If your agency regularly responds to multijurisdictional incidents, you would likely benefit from a similar unified multi-agency approach to data integration. Even if different agencies own different brands of equipment, with NGFR integration approaches the data can be shared through common situational awareness platforms. To plan for multijurisdictional interoperability, bring your regular public safety partners to the table when using this guidance to define your approach to sensor implementation.

Due to the significant differences between agencies and their capabilities around the country, there is not a one-size-fits-all approach for patient physiological sensors. However, DHS S&T believes that these questions will help guide your agency and partners towards implementing and deploying patient monitoring solutions that are right for your community.

Determine Patient Monitoring Requirements

The first step for your agency is to assess your patient monitoring requirements. DHS S&T recommends involving a variety of EMS and public health officials at different levels of command in your requirements discussion to ensure all perspectives are considered. Discussion topics include:

- **Who**: Who needs access to patient monitoring? Will different types of EMS teams need different types of sensors? Who, aside from the EMS team, needs access to the patient monitoring data to understand the status of triage during an MCI (e.g., hospitals, Incident Commanders, EOC)?
- **What**: What is the scope of patient monitoring solutions that your agency requires and has budget for (e.g., types of sensors, situational awareness platforms, number of sensors, ruggedization requirements)? Which options are nice to have versus necessary, and how do your agency and partners prioritize the possibilities?
- **Where**: Where will the sensors be employed? If first responders are wearing sensors in the field, what durability and environmental requirements will the devices need to meet (i.e., heat resistance for firefighter sensors)? Are there other agencies or jurisdictions that could benefit from the data? Will it be deployed to the edge (incident scene) or mostly used by command at a public safety answering point (PSAP) or station house? Will the sensors and situational awareness platforms be easily deployable for significant multijurisdictional incidents or mutual aid situations?
- **When**: Does your agency need sensor solutions on a full-time or part-time basis? Is it a surge capability for major incidents, used to manage everyday incidents, or both?

Identify Current Patient Monitoring Capabilities

The second step is for your agency to determine your current patient monitoring capabilities, particularly those for managing MCI triage. Discussion topics include:

- What patient monitoring sensors are currently in use by your or other participating agencies? Are they able to send data wirelessly? Think of networked and non-networked sensors, including those in ambulances.
- How are those sensors currently deployed by your or other participating agencies? How is the sensor data currently used?
- What vital signs do current sensors and/or systems detect?
- Are these patient monitoring systems integrated with any situational awareness platforms? If not, are they capable of integration?
- What situational awareness platforms (if any) are in operation?
- Does your agency have the network infrastructure needed to pass sensor data to your existing or planned situational awareness platforms?
- Do EMS responders have access to smartphones and/or tablets (issued by agency or personal)?

Identify Patient Monitoring Solutions

Once your agency has determined your patient monitoring requirements and current capabilities, you need to identify which solutions can fulfill those gaps. Your agency should follow internal guidance to evaluate the costs of and functionality provided by each solution to determine which one(s) to select.

First, determine which types of sensors are necessary based on your patient monitoring requirements:

- Physiological sensors;
- Location sensors; or
- Combined physiological and location sensors.

Your agency then needs to identify legacy (or new) situational awareness platforms that you wish to integrate into, considering:

- CAD systems;
- Map-based situational awareness applications; and
- Collaboration and messaging applications.

Finally, your agency needs to consider the technical requirements of implementing a situational awareness system with real-time patient monitoring sensor integration onto situational awareness applications. Discussion topics include:

- What are the technical capabilities of agency-provided or bring-your-own-device smartphones, tablets and computers (ruggedization, storage, network access, data plans, processing power)?
- What are the technical capabilities of internet access in the field, including bandwidth for pushing steady streams of sensor data and/or large packets of video and voice data?
- Does your agency have adequate technical support staff for set-up, device management and troubleshooting?

Note: for a more complete review of data integration requirements, please see the "NGFR Case Study: Data Integration," referenced in the References and Recommended Reading section.

Implement Solutions

Once your agency has selected the patient monitoring sensor, situational awareness and data integration solution(s), you should develop an implementation plan for the system(s). The plan would include processes for:

- Procurement of the software and hardware;
- Installation of the components;
- Configuration of the devices and associated applications;
- Privacy, HIPAA and legal requirements for managing and protecting patient health information;
- Training support personnel on the maintenance of the devices and applications; and
- Training the first responders on using the systems.

After implementing and testing patient monitoring sensors, your agency will be able to monitor real-time patient data and alerts, allowing EMS staff to make better-informed decisions during everyday response and major incidents.

SUMMARY

This NGFR case study provided an overview of the NGFR – Harris County OpEx, with a focus on implementing patient monitoring sensors to augment mission response through real-time triage updates during a Mass Casualty Incident. It also provided a discussion guide that may help your agency determine requirements, current capabilities, target capabilities and implementation considerations for patient monitoring solutions.

If your agency finds this NGFR case study useful for improving your patient monitoring capabilities and solution implementation, DHS S&T would greatly appreciate your feedback. Please contact the NGFR team with stories from the field, questions or comments by emailing NGFR@hq.dhs.gov.

Figure 8. OpEx Director Sridhar Kowdley Describes How OpEx Technologies are Deployed

REFERENCES & RECOMMENDED READING

Next Generation First Responder Apex Program (https://dhs.gov/ngfr)

This website provides NGFR Apex program descriptions, updates and knowledge products.

NGFR Integration Handbook (https://dhs.gov//science-and-technology/ngfr/handbook)

This three-part document provides technology developers with a standards-based architecture for developing and integrating interoperable first responder technologies.

NGFR – Harris County OpEx Playbook, expected February 2020 (will be posted on https://dhs.gov/ngfr and available upon request from NGFR@hq.dhs.gov)

This document is the guide that was used to execute the NGFR – Harris County OpEx.

NGFR – Harris County OpEx After Action Report, expected March 2020 (will be posted on https://dhs.gov/ngfr and available upon request from NGFR@hq.dhs.gov)

This document thoroughly describes the planning, execution and results of the NGFR – Harris County OpEx.

NGFR Case Study: Data Integration, expected February 2020 (will be posted on https://dhs.gov/ngfr and available upon request from NGFR@hq.dhs.gov)

This document describes sensor data integration during NGFR – Harris County OpEx.

NGFR Case Study: Enhanced Situational Awareness, expected February 2020 (will be posted on https://dhs.gov/ngfr and available upon request from NGFR@hq.dhs.gov)

This document describes situational awareness applications during NGFR – Harris County OpEx.

NGFR Case Study: Mobile Device Management, expected February 2020 (will be posted on https://dhs.gov/ngfr and available upon request from NGFR@hq.dhs.gov)

This document describes mobile device management during NGFR – Harris County OpEx.

NGFR Case Study: Sensor and Event Alerts, expected February 2020 (will be posted on https://dhs.gov/ngfr and available upon request from NGFR@hq.dhs.gov)

This document describes standard formats for sensor and event alerts during NGFR – Harris County OpEx.

NGFR Case Study: Sensors, expected February 2020 (will be posted on https://dhs.gov/ngfr and available upon request from NGFR@hq.dhs.gov)

This document describes various sensors used during NGFR – Harris County OpEx.