Vehicle Tracking Technology Systems

Market Survey Report

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FOREWORD

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions. Located within the DHS Science and Technology Directorate (S&T), the SAVER Program conducts objective assessments and validations on commercially available equipment and systems and develops knowledge products that provide relevant equipment information to the emergency responder community. The SAVER Program mission includes:

- Conducting impartial, practitioner-relevant, operationally oriented assessments and validations of emergency response equipment.
- Providing information, in the form of knowledge products, that enables decision-makers and responders to better select, procure, use and maintain emergency response equipment.

SAVER Program knowledge products provide information on equipment that falls under the categories listed in the DHS Authorized Equipment List (AEL), focusing primarily on two main questions for the responder community: "What equipment is available?" and "How does it perform?" These knowledge products are shared nationally with the responder community, providing a life- and cost-saving asset to DHS, as well as to Federal, state and local responders.

The SAVER Program is managed by the National Urban Security Technology Laboratory (NUSTL). NUSTL is responsible for all SAVER activities, including selecting and prioritizing program topics, developing SAVER knowledge products, coordinating with other organizations and ensuring flexibility and responsiveness to first responder requirements.

NUSTL provides expertise and analysis on a wide range of key subject areas, including chemical, biological, radiological, nuclear and explosive hazard detection; emergency response and recovery; and related equipment, instrumentation and technologies. For this report, NUSTL conducted a market survey of commercially available vehicle tracking technology systems. These systems fall under AEL reference number 04AP-02-AVLS, titled Systems, Automatic Vehicle Locating.

For more information on NUSTL's SAVER Program or to view additional reports on vehicle tracking technology systems or other technologies, visit www.dhs.gov/science-and-technology/SAVER.

POINT OF CONTACT

National Urban Security Technology Laboratory (NUSTL)
U.S. Department of Homeland Security
Science and Technology Directorate
201 Varick Street
New York, NY 10014

E-mail: NUSTL@hq.dhs.gov
Website: www.dhs.gov/science-and-technology/SAVER

Author:
Rob Casparro, General Engineer/Operations Analyst

EXECUTIVE SUMMARY

First responder agencies' command and control centers must be able to react to emergency situations in a quick, efficient manner, dispatching units to the scene of emergencies as soon as possible to prevent tragedies such as loss of life or loss of property. This process is complicated for agencies with large, complex fleets of emergency vehicles. Knowing the exact locations of these vehicles can help optimize the process of dispatching units based on proximity and available personnel, for example. Some emergency responder agencies are considering utilizing vehicle tracking technology (VTT) systems to enhance their emergency response capability.

To assist emergency responders interested in VTT systems, NUSTL's SAVER Program conducted a market survey of commercially available systems capable of tracking a large fleet of more than 1,000 vehicles. Products included in this market survey report can provide near real-time positional tracking of responder vehicles across various operating system platforms. They may also have additional capabilities such as providing mapped fire hydrant locations or driver performance ratings.

This market survey identified eight VTT systems that may be used to monitor the near real-time locations of a large fleet of responder vehicles. All products are compatible with multiple operating systems (i.e., Windows, iOS and Android). Several products can map the locations of many vehicles at the same time. One product includes the ability to deliver digital alerts to civilian vehicles to warn them of approaching emergency vehicles. Prices for the VTT systems vary depending on the number of vehicles tracked and the length of the licensing agreement.

Emergency responder agencies that are considering VTT systems should carefully research each product's overall capabilities and limitations in relation to their agency's operational needs. Agencies should also consider system compatibility with their existing information technology infrastructure, ease of integrating hardware into emergency vehicles and any required maintenance.

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1.0 INTRODUCTION

Vehicle tracking technology (VTT) systems provide near real-time mapping of vehicle fleets over a variety of operating system platforms. They are often utilized by commercial entities such as trucking companies or delivery services. Some systems are equipped with software that can optimize delivery routes to conserve fuel or monitor driving habits to ensure that operators observe speed limits.

VTT systems have the potential to increase the situational awareness of emergency responder agencies' Command and Control (C2) centers, particularly for agencies with large, complex vehicle fleets like those of urban fire departments that may have more the 1,000 vehicles—including chiefs' vehicles, fires engines and ambulances—in their fleets. The capability to track all these vehicles with precision would increase the efficiency with which they can be dispatched by C2 centers, potentially saving lives and preventing property damage by increasing response time.

To prevent the possibility of hacking, which could disrupt the emergency response mission, responder agencies may wish to focus on those VTT systems that track fleets without connecting to their vehicles' onboard computers.

In addition, VTT systems can alert civilian vehicles of approaching emergency response vehicles, allowing civilian drivers to move out of the way, minimizing delays and collisions. This technology is known as Responder-to-Vehicle (R2V) communication. Presently, collisions with civilian vehicles en route to emergencies is a leading cause of injury and death among responders.[i] Reducing the risk of in-transit collisions will save lives (first responders and bystanders) and improve the agency's risk profile.

To provide emergency responders with information on commercially available VTT systems, the System Assessment and Validation for Emergency Responders (SAVER) Program conducted a market survey. This market survey report is based on information gathered from September 2019 through December 2019 from internet research, industry publications, a government-issued Request for Information (RFI) that was posted on the Federal Business Opportunities website and subsequent contact with equipment manufacturers and vendors. The U.S. Department of Homeland Security (DHS) Science and Technology Directorate's (S&T's) Technology Scouting group also contributed to the market research used in the development of this report. This report encompasses vehicle tracking systems with the following characteristics:

- Capable of providing near real-time mapping of a large fleet of vehicles
- Compatible with various operating systems (i.e., Windows, iOS, Android, etc.)
- Function independently from the emergency response vehicle's onboard computer

Due diligence was performed to develop a report that is representative of products currently available in the marketplace.

[i] The Emergency Vehicle Safety Initiative (U.S. Department of Homeland Security (DHS), Federal Emergency Management Agency, February 2014) stated that "historically approximately 25 percent of all firefighter fatalities in the United States are the result of vehicle-related incidents" and "at the time of this report, vehicle-related fatalities were the leading cause of death to law enforcement officers in the United States for 11 of the 12 previous years". Note that not all vehicle-related incidents occur when responding to emergency scenes on roadways; it also includes vehicle crashes in both official and personally owned vehicles.

2.0 VEHICLE TRACKING TECHNOLOGY SYSTEMS OVERVIEW

Market research on VTT systems turned up over thirty products currently available in the marketplace. The configurations and features vary among different manufacturers, but generally all of them utilize the same basic principles.

2.1 CURRENT TECHNOLOGY

The primary components of a VTT system include a hardware unit that is installed in each vehicle to be tracked, a connection to a communications network of some sort and a software interface that displays the near real-time locations of each vehicle. The installed hardware is typically a transponder that transmits and receives tracking signals, usually over a cellular network. The software package provides tracking services and an interface that enables a vehicle mapping display, usually on a web page or mobile application.

The transponder is directly connected to vehicle power, though some units also have a battery backup. Some products connect to the vehicle's onboard computer, allowing them to track information such as average fuel economy and vehicle maintenance requirements. Products that connect to the vehicle's onboard computer were excluded from this report, as responder agencies may deem this feature undesirable for security reasons. For units that deliver digital alerts to civilian vehicles, the hardware is connected to a switchable control in the vehicle, such as a lightbar. The digital alerts are only broadcast when the lightbar is activated, meaning when the vehicle is responding to an emergency.

2.2 EMERGENCY RESPONSE APPLICATION

The primary application of interest for responder agencies is to provide improved situational awareness to dispatch centers and potentially reduce deployment times of first responder vehicles. When an emergency call is received, dispatch staff would use the VTT system to identify an appropriate response vehicle based on the vehicle's location, type, personnel and other factors. As the unit responds to the emergency, dispatch staff would be able to continuously monitor its location and dispatch other emergency vehicles to the location as needed.

VTT systems that include the R2V communication feature can warn nearby civilian vehicles of the approach of emergency responder vehicles via a vehicle dashboard indicator, radio broadcast or smartphone navigation application alert. Upon receiving the alert, civilians could preemptively pull over before the emergency vehicle needs to pass them, alleviating street congestion and saving valuable time. These improvements may result in faster emergency response times and fewer accidents. Currently, responders rely on civilians yielding the right of way after seeing the responding vehicle's emergency lights or hearing its sirens. In large urban areas, drivers often have a hard time determining where an emergency vehicle is coming from, as large buildings tend to obstruct emergency lights and reflect audible sirens. Additionally, in urban areas with narrow and congested streets, it can be difficult for civilian vehicles to clear the roadway in a timely manner for an emergency vehicle. By preemptively sending drivers alerts, the desired solution could allow drivers additional time to yield, ultimately improving the agency's average response time as a result.

2.3 CONSIDERATIONS

Prior to implementing a VTT system, responder agencies should consider the following capabilities:

- **High Capacity:** Able to do simultaneous, near real-time tracking of a large fleet of over 1,000 vehicles in their entirety
- **Multi-platform:** Compatible with the agency's C2 desktop computers as well as on agency-issued tablets and mobile devices
- **Security:** Any device that will be integrated into an agency's information technology (IT) network will require vetting and approval. Also, there may be some security concerns if the hardware installed in the vehicle connects to the vehicle's onboard computer
- **Availability:** Available for purchase in the next two to three months
- **Alerts Civilian Vehicles:** Provides a method for first responders to alert nearby civilian vehicles of the approach of an emergency vehicle

3.0 PRODUCT INFORMATION

This section provides information on eight vehicle tracking technology products. Product information presented in this section was obtained directly from manufacturers, vendors and their websites. Information in the table is based on data gathered from vendors and their websites from September 2019 to December 2019 and has not been independently verified by the SAVER Program.

The product information in Table 3-1 is defined as follows, listed in column order:

Manufacturer: The manufacturer of the product.

Network Type: The type of communications network used by the system.

Hardware Type: The type of hardware that is installed and/or carried on the tracked vehicle.

Power Source: Indicates if the hardware is connected to vehicle power or runs independently on batteries.

Battery Backup: Indicates if a vehicle-powered unit has battery backup.

Map Display: Indicates if the interface displays a near real-time map showing vehicle locations.

High Capacity: Indicates if the system can simultaneously track and display a large fleet of vehicles (greater than 1,000).

Vehicle Alerting: Indicates if the system can deliver digital alerts to civilian vehicles as an emergency vehicle approaches.

Supported Platforms: Indicates what platforms are supported by the interface software (i.e., Windows, iOS or Android).

Price/Vehicle: Approximate manufacturer suggested retail price for one unit, in U.S. dollars; quantity discounts may be available. "NI" means no information was available about price.

Table 3-1 Product Comparison Matrix

Manufacturer	Network Type	Hardware Type	Power Source	Battery Backup	Map Display	High Capacity	Vehicle Alerting	Supported Platforms	Price/ Vehicle
Geotab	Cellular	Transponder	Vehicle	No	Yes	Yes	No	Windows/ iOS/Android	NI
Globalstar	Satellite	Transponder	Vehicle	Yes	Yes	Unknown	No	Windows/ iOS/Android	NI
HAAS Alert	Cellular	Transponder	Vehicle	No	Yes	Yes	Yes	Windows/ iOS/Android	$29/month (5yr license)
Quartix	Cellular	Transponder	Vehicle	No	Yes	Unknown	No	Windows/ iOS/Android	$18.90/ month
Samsara	Cellular	Transponder	Vehicle	No	Yes	Yes	No	Windows/ iOS/Android	$33-$44/ month
Spotted Dog Technologies	Cellular	Cellphone	Battery	N/A	Yes	Unknown	No	Windows/ iOS/Android	NI
Tactical Edge	Cellular	Transponder/ Cellphone	Vehicle/ Battery	No	Yes	Yes	No	Windows/ iOS/Android	NI
US Fleet Tracking	Cellular	Transponder	Vehicle	No	Yes	Unknown	No	Windows/ iOS/Android	$29.95/ month

3.1 GEOTAB

Geotab Active Tracking is a vehicle tracking platform that can be viewed from both web and mobile applications. Geotab also has an available Software Development Kit (SDK), which allows the software to communicate with third-party vendors' software if desired. Using the SDK, the system will likely integrate well with existing C2 platforms.

Figure 3-1 Geotab GoRugged Vehicle Tracker
Image courtesy of Geotab Inc.

The standard hardware is the GoRugged tracker, which connects to vehicle power. It does not connect to the vehicle's onboard computer. Alternately, the Geotab platform can be purchased as a service and integrated with Global Positioning System (GPS) trackers from other vendors. The software displays near real-time vehicle locations on a map and provides performance trends and efficiency information.

According to the vendor, more than 1.5 million Geotab devices are currently in operation. The Geotab system is currently employed by a state police department to track a fleet of about 1,400 vehicles. Pricing information was not available for this system.

3.2 GLOBALSTAR

Globalstar provides mobile text, e-mail alerting and data connectivity beyond the range of cellular service by utilizing a satellite network. Their SmartOne C product is installed in vehicles and provides near real-time tracking information at almost any location worldwide.

Figure 3-2 Globalstar SmartOne C Monitor
Image courtesy of Globalstar

The SmartOne C monitor connects to the SPOT My Globalstar software, which provides near real-time mapped locations of tracked vehicles as well as live alerts and geofencing features. The software also allows grouping of assets by function for improved organization and situational awareness. The monitors are connected to vehicle power and do not connect to the onboard computer. They also have a backup battery feature for situations where vehicle power is lost, with an estimated battery life of 1.5 years.

Satellite networks have an advantage in that they provide almost unlimited range—as opposed to the limited range of cellular networks—which increases the robustness and reliability of the VTT system. The Globalstar satellite network is utilized by several industries including oil & gas, maritime, forestry and construction. Pricing information was not available for this system.

3.3 HAAS ALERT

The Heedful Audio Alert System, also known as HAAS Alert, provides near real-time fleet tracking as well as autonomous alerting of civilian vehicles when an emergency responder vehicle is approaching. It is currently the only known product that combines these two features. According to the vendor, HAAS Alert has been deployed on nearly 100 first responder agencies in North America.

Figure 3-3 HAAS Alert HA-5 Transponder
Image courtesy of HAAS Inc.

The HAAS Alert system requires a transponder to be installed in each vehicle with line-of-sight to the sky for GPS and cellular connectivity. Alternately, an external GPS antenna can be connected to the transponder. The hardware is connected to vehicle power and connects to a trigger such as the vehicle lightbar or siren control. The digital alerts are continuously sent whenever the trigger is activated. The transponder does not have to be connected to the vehicle's onboard computer. The R2V alerts are delivered through the navigation application Waze as well as in-dash infotainment systems that support Waze (e.g., Apple CarPlay, Android Auto, Ford Sync, etc.). When a HAAS Alert-equipped emergency vehicle approaches, the Waze application displays an on-screen message warning of the approach of a responder vehicle. The vendor plans to add additional platforms to its alerting system in the future.

There is also a feature in development, which will be available at additional cost. This feature will warn emergency vehicles when another emergency vehicle is approaching. This technology is known as Responder-to-Responder (R2R) communication.

The HAAS Alert software includes a vehicle tracking dashboard, which is compatible with any browser via a desktop, laptop, tablet or mobile device. The dashboard displays a map showing the location of each tracked vehicle and includes statistics such as number of vehicles alerted, time-to-scene, time on-scene, etc. According to the vendor there is no limit to the number of vehicles that can be tracked at one time. HAAS Alert also offers an Application Programming Interface (API) that allows users to integrate the software with an existing dashboard. HAAS Alert is sold through licensing agreements, which are available for one, three or five years. According to the vendor, the price per vehicle for a five-year license is about $29/month.

3.4 Quartix

Quartix provides near real-time position tracking of vehicle fleets with two hardware options—hardwired to vehicle power or plugged into the vehicle's onboard computer. The system uses GPS for position information and transmits data over a cellular network. The software displays mapped vehicle locations and can also provide daily vehicle logs and route maps. The dashboard is available on desktop and laptop computers and on mobile devices through an application.

Figure 3-4 Quartix Vehicle Tracking Device
Image courtesy of Quartix Inc.

The software monitors drivers' behaviors and can create tables and graphs displaying data such as speed, acceleration and braking. It generates driver scores based on this data, which provides a method to monitor and compare driver performance.

According to the vendor, Quartix has been installed on over 500,000 vehicles to date. Quartix use cases range from landscaping services to private security. According to the vendor's website, the price per vehicle is $18.90/month.

3.5 Samsara

Samsara's GPS Fleet Tracking software allows C2 staff who need to track large fleets to view their vehicles' locations in near real-time. In addition, the software includes reporting and dashboard outputs that C2 personnel can use to quickly identify performance trends and inefficiencies. Samsara's user interface can be accessed through a web application, and a simplified version is accessible through mobile devices connected to the internet.

Figure 3-5 Samsara VG34 Vehicle Gateway Transponder
Image courtesy of Samsara Inc.

Samsara offers its own line of Vehicle Gateway transponders, which serve as central hubs for sensors and data transmission in vehicles where they are installed. The hub connects to vehicle power and does not have to be connected to the vehicle's computer.

According to Samsara, two of their key municipal clients use Samsara's system to track large fleets of vehicles (greater than 1,000). Samsara claims its solution has live-to-the-second GPS tracking. One city saw a 10% improvement in predictability for commuter bus arrival times using the GPS Fleet Tracking software. Another city uses Samsara's system to support a city-wide push to improve emergency response times, dispatching city vehicles based on their GPS locations. According to the vendor's website, the price per vehicle ranges from $33-$44 depending on the number of vehicles.

3.6 Spotted Dog Technologies

Spotted Dog Technologies' Rover product uses first responders' cellphones as the tracking device; no external hardware needs to be installed in the vehicle. The system connects to the existing C2 platform and allows dispatchers to send messages directly to the responders' cellphones. Responders use an application to designate themselves as en route to an incident, and their locations are automatically mapped by the Rover software.

Figure 3-6 Spotted Dog Technologies Rover Software
Image courtesy of Spotted Dog Technologies

The system was created specifically for firefighters and includes unique features such as arrival countdowns and mapped fire hydrant locations. The mapping feature is available on both web and mobile applications. The application also integrates with Waze and Google Maps, and can provide turn-by-turn directions to an incident location.

According to the vendor, Rover is currently being used by both small and large fire and rescue agencies in the United States, Canada and Australia. Over 25,000 first responders have utilized the system. Pricing information was not available for this system.

3.7 Tactical Edge

Tactical Edge Inc. provides customized technology solutions for both military and commercial customers, including software development, systems modernization and cyber security. Their Total Visibility Anywhere (TVA) product provides near real-time location data for vehicles, shipments and assets. Tactical Edge uses third-party transponders and/or drivers' cellphones for their tracking data instead of proprietary hardware.

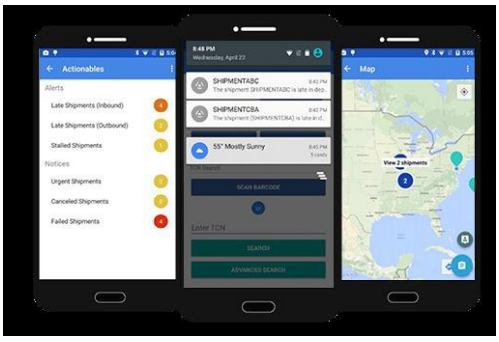

Figure 3-1 Tactical Edge
Total Visibility Anywhere Software
Image courtesy of Tactical Edge, Inc.

The TVA software can be configured to send alerts based on vehicle movements and provides a near real-time map of all tracked vehicles.

There are additional features such as graphs and visualization aids to make the location data more actionable. According to the vendor, the total number of assets that can be tracked is unlimited.

TVA has been used by various trucking and shipping companies, as well as some military applications. Pricing information was not available for this system.

3.8 US Fleet Tracking

US Fleet Tracking provides GPS vehicle tracking service for small and large fleets. The hardware includes a transponder that connects to vehicle power and does not connect to the vehicle's onboard computer. The software uses a web interface that is available on multiple platforms and provides a mapped display of vehicle locations, with updates provided every five to ten seconds depending on the level of service.

Figure 3-8 US Fleet Tracking AT-V4 GPS Tracker
Image courtesy of US Fleet Tracking

The software interface includes live traffic and weather updates to provide situational awareness for C2 staff when dispatching vehicles. It also includes performance trend data and identifies geographical areas where vehicles are concentrated during certain hours of the day. The software also has a geofencing feature that sends an alert anytime a vehicle enters or exits a specified area.

Before expanding to other industries, US Fleet Tracking started out as a near real-time tracking service exclusively for 911 dispatch, law enforcement and emergency medical services (EMS). According to the vendor's website, the price per vehicle is $29.95/month.

4.0 VENDOR CONTACT INFORMATION

Additional information on VTT systems included in this market survey report can be obtained from the manufacturers listed in Table 4-1.

Table 4-1 Vendor Contact Information

Manufacturer	Address/Phone Number	Website/E-Mail
Geotab	770 E. Pilot Road, Suite A Las Vegas, NV 89119 416-434-4309	https://www.geotab.com/ geosales@geotab.com
Globalstar	300 Holiday Square Blvd. Covington, LA 70433 877-452-5782	https://www.globalstar.com/en-us/ info@globalstar.com
HAAS Alert	650 W. Lake Street, Suite 410 Chicago, IL 60661 833-433-HAAS	https://www.haasalert.com/ support@haasalert.com
Quartix	875 N. Michigan Ave., Suite 3100 Chicago, IL 60611 855-913-6663	https://www.quartix.com/ sales@quartix.com
Samsara	444 De Haro Street San Francisco, CA 94107 415-985-2400	https://www.samsara.com/ info@samsara.com
Spotted Dog Technologies	P.O. Box 844 Monroe, CT 06468 833-436-4277	https://www.spotteddogtech.com/ info@spotteddogtech.com
Tactical Edge	2120 Camino Del Rio South, Suite 200 San Diego, CA 92108 619-677-1105	http://www.tacticaledge.us/ info@www.tacticaledge.us
US Fleet Tracking	2912 NW 156th Street Edmond, OK 73013 405-726-9900	https://www.usfleettracking.com/ support@usft.com

5.0 SUMMARY

This market survey report provides information on eight VTT systems capable of tracking and displaying the locations of a large vehicle fleet. The selected VTT systems all can provide a near real-time mapped display of vehicle locations and are compatible with multiple operating system platforms. None of these systems require connection to the tracked vehicle's onboard computer. Most use a transponder, which is installed in the tracked vehicle as the communication source, while others use the drivers' cellphones as the tracking hardware. Seven systems communicate over cellular networks, while one utilizes a satellite network.

One product includes the ability to deliver digital alerts to civilian vehicles whenever an emergency vehicle is approaching. This feature would give civilian drivers additional time to yield to first responder vehicles, potentially alleviating roadway congestion and improving emergency response times. Four of the products assert the ability to simultaneously track a fleet of more than 1,000 vehicles, an important consideration for a large, urban agency or a situation where multiple organizations are looking to provide higher level coordination. One product has a battery backup feature, which would allow vehicle location information to be transmitted even if vehicle power is lost.

Emergency responder agencies that are considering VTT systems should carefully research each product's overall capabilities and limitations in relation to their agency's operational needs. Agencies should also consider system compatibility with their existing information technology infrastructure, ease of integrating hardware into emergency vehicles and any training that may be required with the new system.

6.0 REFERENCES

U.S. Department of Homeland Security (DHS), Federal Emergency Management Agency. (February 2014). *Emergency Vehicle Safety Initiative (FA-336).* U.S. Fire Administration. Retrieved from https://www.usfa.fema.gov/operations/ops_vehicle.html