INFORMATION PAPER

ON NEW TECHNOLOGIES

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Our vision is to advance the Fire/Rescue/EMS services and allied agencies to be on the leading edge of technological adaptation.

Mission

Our mission is to promote an environment that encourages and supports innovation to drive the adoption, adaptation and/or acceptance of technological solutions within a standards-based, interoperable framework.

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Information Paper on Technology for Citizen Notification of Responding Emergency Vehicles

In cooperation with

B&C Electronic Engineering Inc.,
manufacturer of
911ETA

Prepared for the International Association of Fire Chiefs

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Overview

The purpose of this white paper is to introduce and evaluate a technology that has the potential for reducing the number of crashes involving emergency vehicles and the motoring public. This is a new technology that is currently in the testing phase of development, but which should be available on the market within 12 months.

Each year in the United States fatal crashes involving emergency vehicles take the lives of both emergency responders and civilians. According to the National Highway Traffic Safety Administration (NHTSA) approximately 200 people per year are killed and thousands more are injured in crashes involving responding emergency vehicles: law enforcement, fire and EMS. The causes are numerous, however, a recurring cause is the lack of awareness on the part of citizen motorists of the presence of responding emergency vehicles. More effective soundproofing of private vehicles filters unwanted sounds. Unfortunately, that same soundproofing also reduces the effectiveness of emergency warning devices.

A new technology has been developed which will alert motorists of approaching emergency vehicles allowing time to move from traffic to allow emergency vehicles to pass, or to avoid the area of travel. The technology works with existing technology that is already used by many emergency services organizations. It is integrated into common personal devices such as smart phones, PNDs, and GPS devices. In addition, the technology provides warning without requiring any action on the part of the motorist.

The technology has the potential to save lives and prevent thousands of injuries due to crashes involving emergency response vehicles. In addition, warning of the presence of emergency vehicles may reduce response times by providing open traffic lanes. Other benefit is the ability for traffic management in the area of emergency operations.

Scope of the Problem

Crashes involving emergency vehicles during emergency service is a significant problem. The United States Fire Administration reports that approximately 7% of all fire fighter injuries occur during crashes of vehicles responding to or returning from emergency scenes. In addition, over 200 people are killed each year and thousands are injured in crashes involving all emergency vehicles: fire, police and EMS. Most, if not all, of these crashes could have been avoided.

According to the National Highway Traffic Safety Administration (NHTSA), between 2004 and 2009 an estimated 94,000 people were injured in motor vehicle traffic crashes involving an emergency vehicle. See Table 1. This is an average of nearly 16,000 people a year being injured in crashes involving law enforcement, EMS and fire emergency vehicles. That's nearly 44 people a day that are being injured in these crashes. To put the scope of this injury problem into perspective, the Centers for Disease Control (CDC) reports that in 2009 home fires injured 13,050 people in the United States. In short, more Americans are injured from traffic crashes involving emergency vehicles than are injured by home fires.

Table 1

Estimate Of People Injured In Motor Vehicle Traffic Crashes Involving An Emergency Vehicles, By Year, General Estimates System (Ges) 2000-2009 [1]

Year	Total Injured
2004	13,609
2005	16,958
2006	17,134
2007	15,962
2008	14,540
2009	16,205

[1] The above numbers are not actual counts, but estimates of the actual counts. The estimates are calculated from data obtained from a nationally representative sample of crashes collected through NHTSA's General Estimates System (GES). Estimates should be rounded to the nearest 1,000. Estimates less than 500 indicate that the sample size was too small to produce a meaningful estimate and should be rounded to 0.

Here are some brief facts about traffic crashes involving emergency vehicles provided by NHTSA.

- Between 2004 and 2009 it is estimated that 940 emergency vehicles were involved in fatal motor vehicle crashes. Approximately 455 of those crashes occurred while the vehicle was in emergency use, i.e. the vehicle's emergency warning devices were activated. In other words, 50% of the total fatal crashes involving emergency vehicles occur while the apparatus is in emergency use. See Table 2 for more detailed information.
- During that same period, of the 940 overall fatal motor vehicle crashes involving emergency vehicles, 123 involved fire trucks. Of the 123 crashes involving fire trucks, 86 were in emergency use. *Nearly 70% of the fatal crashes involving fire trucks occurred while the apparatus was in emergency use.*
- Between 2004 and 2009, NHTSA estimates that annually approximately 35,000 emergency vehicles are involved in some type of non-fatal crash. Of those 35,000, it is estimated that approximately 3,200 involve fire trucks. That means that nearly 9 times a day, somewhere in the United States a fire truck is involved in a non-fatal motor vehicle crash. See Table 3 for more detailed information.
- Approximately 60% of those crashes involving fire trucks occurred while the apparatus was in emergency use.

Even though these statistics may seem staggering, the actual number of crashes may be even larger. Several states do not report this information to NHTSA. In addition, a phenomenon known as the "wake effect" includes crashes that are never attributed to emergency vehicle response. The wake effect occurs as emergency vehicles respond through traffic and motorists try to move out of the way of the emergency vehicle, inadvertently crashing into other vehicles.

In this study of potential new technology which can be utilized to prevent these crashes, it is important to consider their causes. There are numerous contributing factors to these crashes and a review of the specific causes is outside the scope of this report. However, a review of research on crashes involving emergency vehicles does provide some insight into the more common causes.

A report in 2003, *An Analysis of Emergency Vehicle Crash Characteristics* by Vrachnou, analyzed the causes of fire apparatus crashes in Northern Virginia. The study found that intersections were the most common locations for crashes involving fire apparatus, with up to 80% of crashes in metropolitan areas occurring at intersections.

A study in 1999, *Human Error in Road Accidents* by Green and Senders, analyzed the causes of traffic crashes of all type of vehicles. The researchers found that the most common cause of crashes involved the driver failing to attend to or notice critical information that had been detected in the external environment. This occurred because the driver's attention was focused elsewhere. Failure to notice critical information about the environment around a vehicle is easy to understand in this age of texting, cell phones, integrated sound systems and video players. In addition, better body insulation in vehicles has resulted in the internal environment being free from most external noise including the audible warning sounds from emergency vehicles.

Another contributing factor to these crashes may be a growing American population with some degree of hearing loss. In the United States, an estimated10% of the population has some degree of hearing loss. Any amount of hearing loss decreases the ability of the driver and occupants to detect sounds from the external environment, including the sirens and horns on emergency vehicles. This physical limitation compounds the problems of better insulated vehicles and failure to notice critical information outside the vehicle.

There are numerous consequences from these crashes. Those consequences are financial, human, and operational and are summarized below.

- Human suffering from injuries and the death of loved ones cannot be measured. There is also an emotional cost to emergency responders who are involved in a crash that results in injuries to their teammates and to citizens.
- The financial costs include insurance claims, lost time from work, damage to apparatus and other vehicles, investigations, workers compensation claims and litigation as a result of the crash.
- Operational impact includes delayed response times, resources not arriving at an operation, and reduced traffic flow in the area of the crash.

Table 2

Emergency Vehicles Involved In Fatal Motor Vehicle Traffic Crashes By Year, Emergency Vehicle Type, And Emergency Use Fatality Analysis Reporting System (Fars) 1995-2008 Final & 2009 Arf

Year by Emergency Vehicle Type		Emergency Use			Total
		Not in Emergency Use	In Emergency Use	9	
2004					
	Police	66	44	0	110
	Ambulance	13	19	0	32
	Fire Truck	7	14	0	21
	Total	86	77	0	163
2005					
	Police	60	41	0	101
	Ambulance	19	24	0	43
	Fire Truck	10	17	0	27
	Total	89	82	0	171
2006					
	Police	71	34	0	105
	Ambulance	12	10	0	22
	Fire Truck	4	15	0	19
	Total	87	59	0	146
2007					
	Police	70	59	0	129
	Ambulance	12	18	0	30
	Fire Truck	1	17	0	18
	Total	83	94	0	177
2008					
	Police	52	53	0	105
	Ambulance	14	14	0	28
	Fire Truck	10	14	0	24
	Total	76	81	0	157
2009					
	Police	48	32	3	83
	Ambulance	12	16	1	29
	Fire Truck	5	9	0	14
	Total	65	57	4	126

Table 3

Estimates Of Emergency Vehicles Involved In Non-Fatal Crashes By Year, Emergency Vehicle Type, And Emergency Use General Estimates System (Ges) 1995-2009[2]

Year by Emergency Vehicle Type		Emergency Use			Total
		Not in Emergency Use	In Emergency Use	Unknown	
2004					
	Police	13,219	11,970	1,300	26,489
	Ambulance	1,829	2,142	244	4,215
	Fire Truck	563	1,377	697	2,637
	Total	15,612	15,489	2,240	33,340
2005					
	Police	11,353	12,371	3,330	27,054
	Ambulance	2,294	1,954	461	4,709
	Fire Truck	1,112	1,768	426	3,306
	Total	14,759	16,094	4,217	35,069
2006					
	Police	14,536	11,391	1,796	27,722
	Ambulance	1,952	2,165	650	4,767
	Fire Truck	529	3,167	583	4,279
	Total	17,017	16,723	3,029	36,769
2007					
	Police	9,468	11,820	3,135	24,423
	Ambulance	960	2,152	940	4,052
	Fire Truck	1,983	1,632	8	3,623
	Total	12,411	15,604	4,083	32,097
2008					
	Police	14,177	11,398	3,301	28,876
	Ambulance	1,977	3,136	873	5,986
	Fire Truck	501	2,004	210	2,715
	Total	16,654	16,538	4,384	37,577
2009					
	Police	14,022	10,746	2,646	27,415
	Ambulance	685	1,399	940	3,024
	Fire Truck	1,194	1,185	459	2,838
	Total	15,901	13,330	4,046	33,277

[2] The above numbers are not actual counts, but estimates of the actual counts. The estimates are calculated from data obtained from a nationally representative sample of crashes collected through NHTSA's General Estimates System (GES). Estimates should be rounded to the nearest 1,000. Estimates less than 500 indicate that the sample size was too small to produce a meaningful estimate and should be rounded to 0.

Technology Solutions

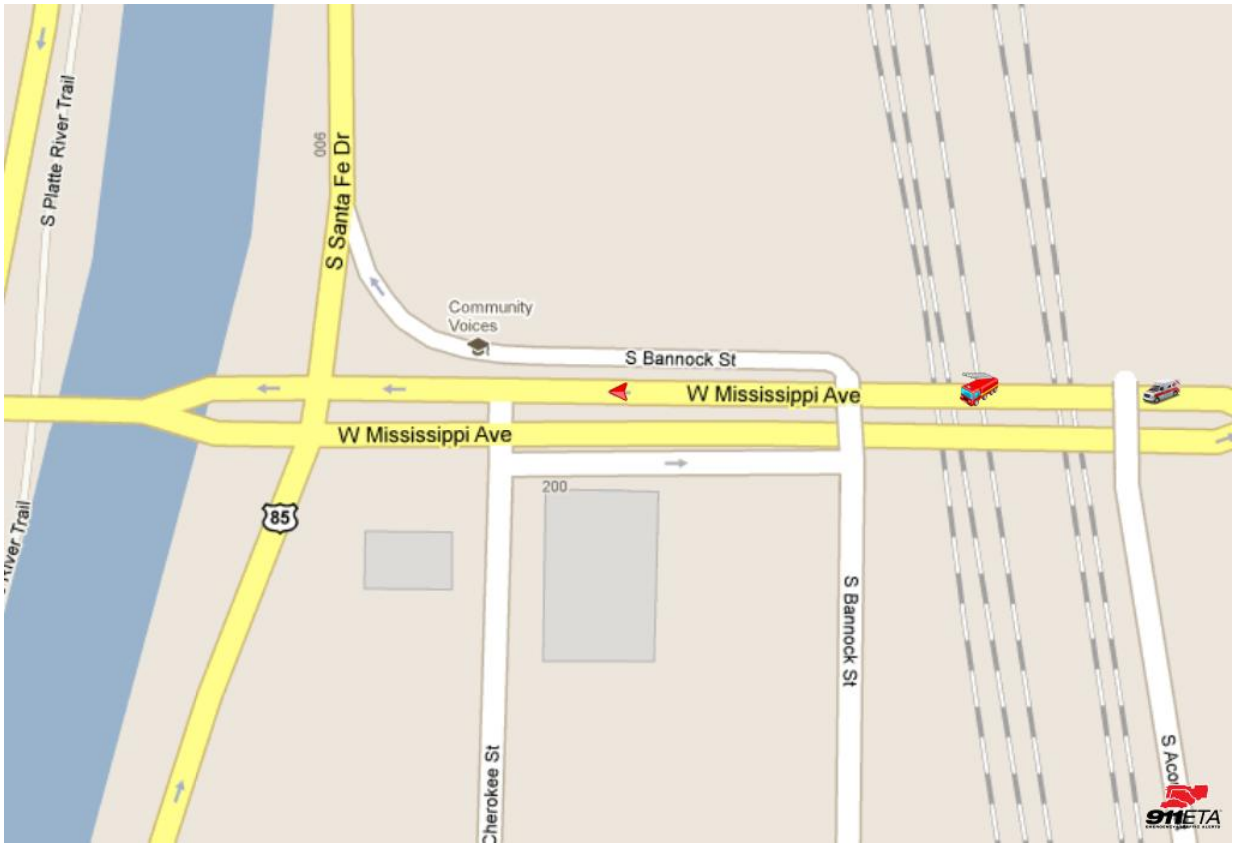
911 Emergency & Traffic Alerts (911ETA) is a revolutionary, patent pending, technology developed by B&C Electronic Engineering Inc. that alerts the motorists to responding emergency vehicles in their area, utilizing streaming live, real-time, data from emergency agencies via smart phones, Personal Navigation Devices (PND's), or in dash Geographical Positioning Systems (GPS). 911ETA targets people and devices that are within a predetermined distance from the responding emergency vehicles or event, i.e. 1,000 feet. It is important to emphasize that 911ETA only reports emergency vehicles which are responding in an emergent mode as dispatched by their dispatch center.

911ETA triggers visual, auditory and vibratory alerts to smart phones and PNDs that is easy to recognize as responding emergency vehicles approach, without having to physically manipulate or read the warning on the device. In other words, the alert is hands-free. In-dash and dash mounted GPS devices will have the same functions as above with the exception of the vibration function. All that is required to receive notification is the device be turned on; the technology does the rest. It must be emphasized that a majority of Americans utilize smart phones and navigation aids. When 911ETA is implemented in a community, a significant number of the drivers in the community will receive emergency notifications.

A sample screen showing a street map without notification from an Apple iPhone® is illustrated in Figure 1.

Figure 1

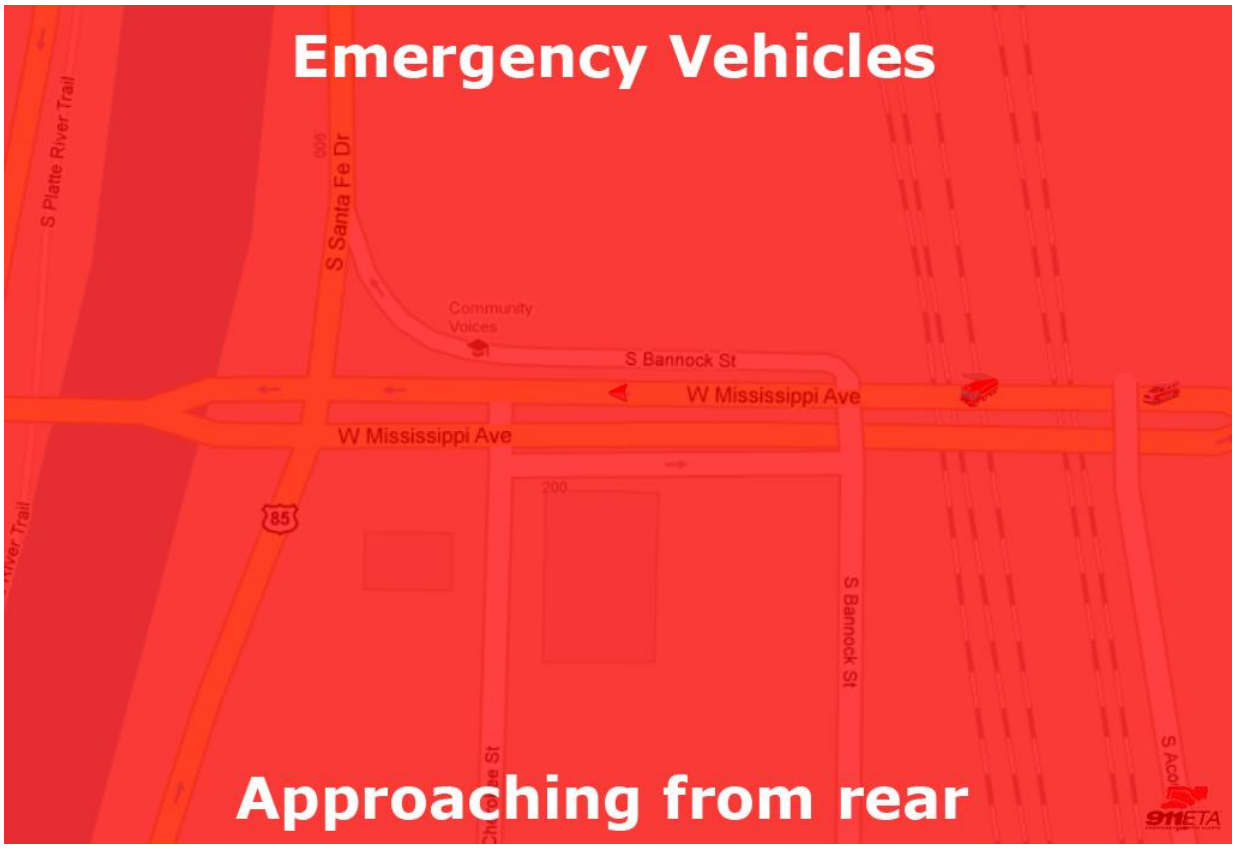
iPhone® Street Map without Emergency Notification



A sample screen showing the visual notification of a responding emergency vehicle on that same iPhone® street map is illustrated in Figure 2.

Figure 2

iPhone® Street Map with Emergency Notification



A sample screen of a street map from a Blackberry® showing the visual notification of a responding emergency vehicle is illustrated in Figure 3.

Figure 3

Blackberry® Street Map with Emergency Notification

911ETA uses existing data that is generated in emergency communication centers around the world and send that information to affected PND or GPS units. This technology is different from other types of alerting systems for three reasons.

1. 911ETA uses real-time data. It warns the public via a live feed of responding emergency vehicles only as they come into close proximity.
2. 911ETA is configurable to given situations. Law enforcement activity that should not be seen by the public can easily be cloaked. Those that should be seen, for public safety, will be displayed.
3. The hardware required for the operation of 911ETA is already in place in most GPS units, PND and smart phones. Much of the hardware required at the Public Safety Answering Point (PSAP) is also in place. This technology does NOT require any additional hardware on emergency vehicles already equipped with Automatic Vehicle Locator (AVL) technology.

Two pieces of information are required to accomplish the task of notifying the public of the presence of responding emergency vehicles. The first is the geographic location of the emergency vehicles. This is accomplished utilizing the AVL located in

the emergency vehicle. The second is the location of the GPS or PND device. PSAP's or 9-1-1 call centers must have AVL devices to track emergency vehicles in order capture the data required by 911ETA. B&C Electronic Engineering will equip the PSAP with a server capable of accommodating the population of the 9-1-1 service area.

911ETA will be available to everyone with a smart phone and other similar devices as it is deployed in their communities. And ultimately it is designed to be packaged in the smart phone or navigation device. This means no additional cost to the user.

The cost to a dispatch center or emergency response agency to implement 911ETA technology will vary depending on the technology hardware already in use by the center or agency. Cost variables include the number of mobile units to be tracked and the size and number of 911ETA servers required. A good rule of thumb is approximately $3,000 per emergency vehicle that will be tracked with an annual maintenance fee of approximately 15% of the installation cost. As mentioned previously, 911ETA requires that emergency vehicles to be tracked and the dispatch center be equipped with AVL technology.

911ETA was developed by B&C Electronic Engineering Inc. (B&C) of Denver Colorado. B&C is a privately held business owned by two former chief officers of the Denver Fire Department. Their combined 60 years of experience as emergency responders led them to develop this revolutionary concept. B&C has been in business for over 26 years. B&C has brought innovative solutions to customers in the communications, car washing, wireless device, and veterinary medicine industries.

The innovation involved in the 911ETA technology has been recognized internationally. In 2010 911ETA was named second runner-up in the NAVTEQ Global LBS Challenge. NAVTEQ is the world's leading provider of maps, traffic and location data enabling navigation, location-based services and mobile advertising. 911ETA was selected as second runner-up from nine finalists in a competition that received more than 200 entries. The selection panel included executives from international companies including deCarta, Imagination Technologies, Intel, and Microsoft Bing Maps.

Benefits

The primary benefit from the use of 911ETA technology is the reduction in vehicle crashes involving responding emergency vehicles. By alerting the public of approaching emergency vehicles, drivers have the time to survey the environment around their vehicle and select a safe route to move out of the way of the emergency vehicle, or select an alternate route away from the responding vehicles. When these crashes are avoided, hundreds of lives will be saved and thousands of injuries will be prevented every year.

Other benefits are summarized below.

- Reduced response time. Traffic delays add time to emergency responses. In heavy traffic areas and times of day, several minutes can be added to a response due to traffic. When drivers are notified of an approaching emergency vehicle, those delays are reduced, resulting in emergency responders providing aid faster. In cases of medical emergencies such as cardiac arrest, those saved minutes may improve patient outcomes.
- Reduced congestion in areas of emergency operations. Drivers will be notified in advance where a group of emergency vehicles are located. Drivers are able to take alternative routes reducing the impact to overall traffic flow. In addition, dispatchers and public works supervisors can use the information to identify potential areas of congestion and reroute traffic as needed.
- Savings on apparatus repair and insurance costs. When traffic crashes are prevented, so is damage to apparatus. Eliminating one crash that would cause extensive damage could save tens of thousands of dollars. If eliminating the crash prevented replacement of an apparatus, the savings is hundreds of thousands of dollars. As the number of claims associated with traffic crashes is reduced, insurance premiums may also be reduced, especially for those jurisdictions that are self-insured.
- Improved public relations. A traffic crash involving an emergency vehicle may have a negative impact to the public's perception of the fire department, especially if the crash was determined to be the fault of the apparatus operator.

Limitations

There are no technology limitations to the 911ETA system. 911ETA utilizes proven technology; technology that is used in other applications in a variety of industries. There are no special applications for the users (citizens) to purchase as the technology works with the applications already in the smart phones and navigation devices. 911ETA technology has been proven to be reliable in beta testing.

The most immediate limitation to implementing the 911ETA technology is the cost of the system. A department that is already utilizing AVL technology would be required to invest an initial cost of approximately $3,000 per emergency vehicle to be tracked. For example, if a department has five apparatus and two staff vehicles that respond to emergencies, an initial investment of approximately $21,000 is required. An additional annual maintenance cost of approximately $3,200 is required.

Another limitation is the cost of installing AVL technology if it is not currently being used. This will require installation of AVL technology on each emergency vehicle as well as installing the technology at the PSAP or dispatch center.

The final limitation is the use of the notification by the driving public. This type of warning message and alert notification is new and will require education of the public on its use. Any implementation of 911ETA should be accompanied by a public awareness campaign to educate the users (citizens) of the meaning of the alert notifications, and the proper response to them.

No other significant limitations to the 911ETA system are noted.

Conclusion

Every year in the United States traffic crashes involving emergency vehicles responding to incidents take the lives of hundreds of citizens and fire fighters and injure thousands more. These crashes most commonly occur at intersections and involve drivers who fail to notice or respond to critical information in the vehicle's external environment. This is compounded by improved sound-proofing of vehicles, a growing number of citizens with some degree of hearing loss, and added distractions from texting, cell phone conversations, etc.

Affordable technology now exists which can alert drivers of approaching emergency vehicles. This technology, 911ETA, alerts drivers and pedestrians through smart phones and personal navigation devices. The alert is automatic when the device is turned on; providing both visual and auditory alerts. No hands-on action is required to receive the alert. When alerted, the driver has the opportunity to move from the path of the emergency vehicle or avoid the route the emergency vehicle is taking.

911ETA has the potential for reducing traffic crashes involving emergency vehicles. Lives can be saved, injuries prevented, and financial impact to individuals, departments and communities eliminated.