E N T E R P R I S E

Next Gen E-911 Project

Phase 1: Survey of E-911 & Emerging Technologies

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1. Introduction

This report is the final deliverable for the project funded by the ENTERPRISE Pooled Fund Study, titled 'Next Generation E-911'. The history of the project dates back to 1993 when ENTERPRISE first partnered with the Federal Highway Administration (FHWA) to pilot the Mayday (emergency notification) project referred to as 'Colorado Mayday'.

Since 1993, numerous Field Operational Tests (FOTs) have been conducted to test Mayday products or services. Also, there are now private Telematics Service Providers (TSP) that offer commercial products that deliver Mayday services to travelers. The most widely known TSP is OnStar, with several million subscribers nationwide.

The premise of this project, however, is not to assume that the challenge of locating stranded or injured motorists in need of urgent care has been completely solved by private sector communication media or TSPs such as OnStar. Instead, this research project is intended to seek opportunities for those who do not subscribe to the monthly services of TSPs, or who have vehicles where TSP products and services are not available.

This document presents a summary of findings of Phase 1 (survey of existing and emerging E-911 technologies). The report is based on an initial status provided to project members and the Enterprise group at the December 2006 meeting. This summary report includes additional research based on the feedback of project members and Enterprise group. The report will be used as the basis of the Phase 2 workshop, as well as the final report (Phase 3).

2. Project Approach

The approach to this project was defined as three key 'phases' of research outlined below:

- Phase 1 - Researching available or emerging technology solutions to the challenge of locating stranded and/or injured motorists.
- Phase 2 - Facilitating discussions with emergency responders such as DOTs, law enforcement and medical professionals regarding the opportunities these additional technology solutions offer. Phase 2 also includes interacting with the Next Generation E-911 industry to discuss how these solutions may impact the Next Gen E-911 development.
- Phase 3 - Summarizing the findings and conclusions into a Final Report.

2.1 Phase 1: Research on Available or Emerging Technology Solutions

Efforts in Phase 1 are intended to review current trends in E911 location and conduct literature searches to identify any additional solutions to the Mayday challenge that may be able to complement the commercial products available today. The intent is to identify solutions that may be used by travelers regardless of the make/model/year of the vehicle, and that could some day be offered at a price that is affordable for all travelers. The approach of Phase 1 is to develop profiles of these alternate solutions, for discussion and consideration. Therefore, the focus is not on promoting (or attempting to promote) any particular product or vendor, but rather on presenting facts about options that could be pursued.

2.2 Phase 2: Workshop Discussions with Industry Representatives

Following the research and documentation in Phase 1, Phase 2 will share the research results with a group of individuals that will be assembled as experts in the area of emergency notification. This group is likely to include individuals from the commercial TSPs (OnStar has already been notified and indicated willingness to work with this group), as well as representatives from the medical, law enforcement, and transportation industries. This group may meet by way of a series of conference calls, or a larger workshop meeting in association with an event such as the National Emergency Number Association (NENA) annual conference.

The intent of Phase 2 is also to share information about the candidate technologies with members working on the National Next Generation E-911 initiative as it is believed that these solutions should be considered in the planning and design of Next Generation E-911.

2.3 Phase 3: Documentation in a Final Report

Finally, a Final Report will be developed in Phase 3 that includes results of the research carried out in Phase 1 and a summary of discussions with the industry participants that occurred in Phase 2.

3. Enhanced 911 Summary

Enhanced 911 (E911) provisions were established by FCC order in 1996 to establish proper routing and location reporting for wireless 911 calls. A subsequent next-generation E911 order was established in 2005 to include provisions for voice over IP (VoIP) telephony.

The initial wireless E911 order was divided into three phases. Phase 0 (actually pre-dating the E911 order) requires that wireless carriers transmit all 911 calls to a Public Safety Answering Point (PSAP), irrespective of whether the caller subscribes to the carrier's service or not. That is, even if a phone has no active service/account, or it is outside the active provider's service area, a wireless provider receiving a 911 call must route it to a PSAP—T-mobile must route a Verizon customer's 911 call.

Phase I of the E911 implementation requires wireless carriers to provide the PSAP with the telephone number (automated number identification, or ANI) of the originator of a wireless 911 call and the location of the cell site or base station transmitting the call. While not allowing the PSAP to determine the exact location of the caller, the process allows routing the call to the proper local PSAP.

Phase II of the E911 implementation requires wireless carriers to provide more precise location information to PSAPs, specifically, the latitude and longitude of the caller, accurate to within 50-300 meters (depending on the location technology used). Tower-based "triangulation" systems must be accurate to within 300 meters for 95% of calls, and accurate to within 100 meters for 67% of calls. Handset based GPS chip systems must be accurate to 150 meters for 95% of calls, and accurate to 50 meters for 67% of calls.

3.1 Next-Generation E911

The FCC is currently in the process of establishing further guidelines for 911 location reporting with a focus on Voice over IP (VoIP) and other new technologies such as text messaging. These enhancements are at an early stage, though VoIP providers have had to establish basic means for transmitting 911 calls to a local PSAP, as well as providing ANI/ALI that allows PSAPs to determine the local address (or mapped location) of the caller. In its early planning stages, NG E911 will revolutionize the way PSAPs are able to respond to incoming calls and data.

3.2 Current Status of Wireless E911

The current status of the E911 regulations for wireless providers is a matter of some debate. Although wireless providers have had to provide the location data as of 2006, recent surveys (2007) indicate that at many as 40% of U.S. county PSAPs (mostly rural) do not have the systems in place to locate callers, even if location data is provided by wireless carriers. Also, many smaller and rural wireless providers have filed for extensions with the FCC because they have not yet been able to meet the E911 requirements.

All of this indicates a significant gap in the ability of emergency responders to effectively locate a stranded motorist based on wireless automated location information. Making matters worse, the triangulation method of location determination requires that the caller be within range of 3 cell towers. This is common in densely populated metro areas, but increasingly unlikely as callers move into rural coverage areas.

4. Technology Survey

The Phase 1 report for this project evaluates several new and emerging "Mayday" technologies. The objective is to provide a brief survey of potential solutions, for discussion and further research or promotion by the ENTERPRISE group. The approach is to examine three categories of emergency communication devices, outlined below. These categories are general in nature, as there is often overlap among them.

1. ***Personal communication devices.*** Personal communication devices include any portable communication device capable of providing location information. These devices may function similarly to in-vehicle communication devices (e.g., GM OnStar) but do not require the infrastructure of a vehicle. Examples include cell phones, wireless PDA, portable GPS/navigation systems and personal locator beacons.

2. ***Vehicle based communication devices.*** These types of solutions would include the products of telematics service providers such as OnStar and ATX. These would typically include some form of vehicle positioning (i.e., GPS), and communication (i.e., cellular or satellite communications). Other potential examples include vehicle-to-curbside and vehicle-to-vehicle communications.

3. ***Road infrastructure devices.*** Road infrastructure devices include any notification system installed as part of the road infrastructure. In the simplest form, this category includes roadside call boxes. Other examples may include isolated emergency call buttons, or detection devices such as cameras that might detect vehicles leaving the roadway. Cutting edge examples might include vehicle-to-curbside communications, as envisioned under the VII initiative.

For each technology that is identified in the areas above, efforts in Phase 1 are intended to document the following information about each potential solution:

1. ***Summary.*** An overall summary of the technology or approach.

2. ***Ownership.*** Is the solution a product or service that is owned privately? Is it a product or service of a public agency? Is it a concept yet to be developed into a product? Does the approach include devices that are marketed and sold as a product, or is it simply research at this stage?

3. ***Market readiness.*** Is the solution in full operation, or in the research and development stage? What is the extent of current market penetration, or feasibility of wide scale adoption?

4. ***Reliability.*** Has the approach and/or technologies been tested and proven?

5. ***Geographical Coverage.*** What is the operational "coverage" or geographic availability of the technology?

6. ***Role for ENTERPRISE?*** Is there a role for ENTERPRISE in either evaluating the technology or approach? Is there a role in helping to ease the entry of the solution into the transportation industry?

7. ***Longevity.*** What is the longevity of the approach? Is there a sustainable business model that would allow this to be supported for a long time?

4.1 Personal Communications Devices

In many ways, personal communications devices are generally the most affordable and practical method for contacting emergency response. However, as the following technology summaries indicate, some devices are more practical and affordable than others. Difference devices have difference purposes, coverage, and reliability.

4.1.1 Emergency GPS Cell Phones

Summary

There is a small but growing market for "emergency use" cell phones that include GPS chips that can be used to locate the caller. These products are primarily marketed as tools to track and locate children or disabled elderly; however they are also promoted as emergency cell phones.

Figure 1: S-911 PinPoint Personal GPS

Products surveyed include:
- Whereifone
- PinPoint Personal GPS (Clayton Communications)
- FoneFinder (Tendler Cellular)
- S-911 Personal Locator (Lapaic Technology)

The phones typically feature a "one button" emergency call, though some have one or more programmable buttons to contact a family member or local emergency service. A few products are regular, functional cell phones wit GPS. Activating the emergency call function dials the emergency dispatch center operated by the products service company. The cell phone delivers a data packet with the phone call so that the dispatcher answering the call is able to view the position of the caller on a terminal at their dispatch station. It is not at all clear to what extent these services are integrated with the 911 network, or are able to transfer the call and location information easily to a local PSAP.

The purchase price for handsets ranges from $50-$400, depending upon the feature set and quality of the devices. The devices require a monthly service plan with the technology provider. Services plans range from $20-$50 per month. Most have the ability to sign up for additional concierge services (delivered when you push the button and the call is answered by their answer support team).

The solutions surveyed would not be practical as a "daily use" cell phone, as talk-time is extremely expensive compared to standard cellular services providers.

Ownership

The products are typically owned and operated by publicly traded or private companies that act as cellular service resellers (that is, the products piggy-back on the wireless networks of the major providers).

Figure 2: Whereifone GPS Phone

Market readiness

There is a range of products on the market. This market faces increasing competition from the major wireless providers, who are also beginning to offer location tracking services (GPS or Triangulation), particularly for monitoring children or the elderly. Because the major wireless providers can provide the location services with an affordable standard service plan (and standard handsets), it remains to be seen how well the dedicated emergency services will fare.

Reliability

The systems are well tested and have been established as very reliable. They are dependent on the underlying digital wireless networks, and face the same limitations as a typical cell phone.

Geographic Coverage

Geographic coverage includes any location that is covered by digital wireless networks (any provider). Essentially, the emergency provider is reselling wireless access as "roaming" on the major wireless networks. This factor provides some coverage advantage over "triangulation" location services provided by the major wireless network providers.

Potential Role for ENTERPRISE

This appears to be a product and service that meets many of the Mayday needs of rural travelers. Further activities might include:

1. Investigating the degree to which the systems are (and can be) integrated with the E911 system. Is there a way that the service providers can easily transfer calls and location data to a PSAP local to the caller?
2. Because this technology is GPS based, it is not subject to triangulation difficulties encountered in rural areas by tower-based location services. Formal functionality testing (i.e., verifying such things as the ability to work on all cellular networks in all areas, verifying the accuracy, and verifying the ease of use) would be useful.

3. Testing the accuracy of the GPS location in urban 'canyon', mountain canyon and rural tree-lined streets would be effective.

Longevity

Although both GPS services and various forms of cell phone location services are growing, emergency cell phones are still a niche market. The technology is sure to be widely available and used for the foreseeable future, though individual service providers appear somewhat unstable. During the course of this project, two "GPS Emergency Wireless" providers ceased doing business. Notably, it remains to be seen to what extent the major wireless providers incorporate GPS and other location services into their packages. Emergency GPS location services may become a standard option for most cell phones in the near future.

4.1.2 Satellite Phones

Summary

Satellite phones are of potential interest as a Mayday communications device because they offer near universal geographic coverage. The two major satellite phone service providers (Globalstar and Iridium) were surveyed for this report.

Before the ubiquity and affordability of cell phone coverage (at least in metro areas), great hope existed that satellite telephones would emerge as a vibrant market, eventually reaching the everyday consumer. Many believed that costs of ownership and usage would come down to the point that the technology would be accessible to casual users, in much the same way that cell phones are available today. However, despite such hopes a broader market remained elusive, and costs remained high. The vast initial cost of establishing the first satellite constellations proved a barrier to affordability and, early telephone handsets were massive in size, making them inconvenient. The satellite phone industry faltered, while the terrestrial radio (cell phone) market exploded.

Figure 3: Globalstar GSP 1700

As the cell phone market exploded, many pronounced the satellite phone industry dead, at least as far as the average consumer was concerned. For a time satellite phones remained the exclusive domain of 24-hour news services and other "mission critical" business applications. However, in recent years, several factors have contributed to the re-emergence of the industry. The conflicts in the Iraq and Afghanistan have greatly increased the need for satellite phone use, particularly among contractors, news agencies, the military, non-governmental organizations and even civilians. Second, the recent hurricane Katrina disaster in Louisiana and Mississippi brought to light the urgent need for alternatives to wire line and cell phone communications. Rescue and recovery efforts were hampered because wire line and cell phone infrastructure were significantly damaged, and massive demand overwhelmed what infrastructure remained. Finally, corporate buyouts and restructuring in the satellite phone industry have allowed the providers to write off some of their initial investment debt and achieve solid growth potential. All of these factors have contributed to both a burst of technological development and a reduction in costs to the end consumer.

Today, satellite phones are re-emerging as a legitimate consumer option, particularly for rural users who may not have good cell phone coverage. Today's typical handset is slightly larger than a standard cell phone, with many of the same features. Many are also dual-use, and can make GSM or CDMA digital cellular calls as well as satellite calls. Satellite handsets currently cost in the range of $600-$1000. This is still far more expensive that a typical cell phone, but at least viable for a consumer who may not have good cell coverage available.

Airtime packages have also come down drastically in price. Currently Globalstar offers a 3-year unlimited talk-time and data plan that costs $49.99 per month for year one, $39.99 per month the second year, and $19.95 per month in subsequent years. In most respects this plan is more affordable than an equivalent cell phone plan. Although the consumer would pay a premium for the handset, the overall cost is competitive with cell phone coverage. Globalstar also offers a flat $29.99 per month emergency plan that does not include talk-time minutes.

Both Globalstar and Iridium offer 911 services, as required by the FCC in 2005. 911 calls are transferred to the service provider's operations center where an operator answers the call. The operators are able to determine the position of the caller (using satellite triangulation) and use this information to relay the call to a local PSAP.

Ownership

The satellite services are owned and operated by Globalstar and Iridium, and market services to government, industry, and the private sector.

Market readiness

The product has been available for several decades, and is well tested and established. Only recently have costs reached a point that individual consumers might consider the services.

Reliability

Satellite phones have proven extremely reliable and are used by government, media, mission critical business operations and the military.

Geographic Coverage

Iridium services are truly global, offering pole-to-pole coverage. The Globalstar satellite network provides continental coverage, but does not extend to mid-ocean or polar coverage. Satellite communications require "line of sight", and thus do not work indoors, and may have reduced coverage in mountain canyons. Dual-use phones that include cellular access will work indoors using the cellular network.

Potential Role for ENTERPRISE

The potential of this technology and its greatly reduced pricing make it an attractive area for further investigation. Further activities might include:

1. Investigating the accuracy with which emergency calls are located and routed to the nearest PSAP. Determining whether local PSAPs have the technology to receive location data automatically, or whether the process is manual.
2. Field testing the phones in rural areas where cell phone coverage is known to be a problem.

Longevity

The satellite phone industry has been around for decades and includes billions of dollars of investment in technology, satellite launches and service improvement. There is little chance that satellite communications will disappear, and in fact, as the summary above indicates, the industry is seeing a resurgence of growth. All signs suggest that satellite telephony will continue to be an important platform.

4.1.3 Personal Locator Beacons

Summary

Personal locator beacons are designed to be carried by individuals (e.g., hikers, climbers, boaters). They can only be activated manually, and operate exclusively on 406 MHz satellite system. The 406MHz satellite system allows location to be determined to within a few miles. There is also a low-power 121.5 MHz homing beacon that helps rescuers home in on the device once they reach the general area. Some models of PLBs also offer a GPS encoded position, therefore delivering location reports at approximately a 100 meter accuracy.

Figure 4: McMurdo Fastfind PLB

The use of PLBs in America has been authorized by the FCC since July 1, 2003. Prior to this date, Alaska was the only state where PLBs were authorized.

The satellite communication signal is received by NOAA and relayed to appropriate responders. This system is clearly an emergency distress signal alert. The primary targeted users are hikers, campers, or others in remote areas who are imminent danger. The descriptions of this service do not describe stranded motorists as a market; however there is nothing that would preclude a stranded motorist from using it in an emergency. Ultimately, the decision about whether to activate the beacon is up to the person or persons in distress. There is no penalty for improper activation, unless the activation is a flagrant violation of its intended use.

Any "Mayday" promotion of this solution would need to emphasize that the use is intended solely for emergency situations. This may include isolated vehicles not seeing any other vehicles, and other such events such as exiting the roadway into a ditch or ravine where the vehicle is not visible from the road.

The PLBs are sold by independent vendors, and typically range from $200 - $1,000, depending upon the features (e.g. whether GPS is included). All PLBs must be registered with the NOAA Satellite and Information Services, and on-line registration has been available since August 2003.

Ownership

The response to emergency beacon signals is performed by NOAA, who alerts appropriate local authorities. The PLB products themselves are sold through a variety of vendors offering various solutions.

Market readiness

Prior to FCC approval for full use in America, there had been 400 lives saved in Alaska using this system. The products are available for sale, and the emergency response and search and rescue are currently performed.

Reliability

The functionality of the PLBs has been tested and demonstrated. The level to which each individual vendor has tested the product (or is required to test to be FCC compliant) is not known at this time.

What has not been discussed in the literature is how the NOAA responders would agree with widespread use by motorists.

Geographic Coverage

PLBs work globally, as long as the PLB device has light-of-sight to the sky (to reach the satellites). PLBs may not work in a vehicle, particularly if they are not positioned near a window.

Potential Role for ENTERPRISE

The potential of this technology for Mayday purposes is worthy of further research. Low cost, universal geographic coverage and lack of recurring service fees make it attractive. Further activities might include:

1. Leading discussions with the NOAA Satellite and Information Services group and the FHWA and NHTSA representatives with interest in Mayday services to determine the feasibility of promoting PLB use by motorists.

2. Determining whether authorities can respond selectively to alert beacons. For example, based on location (such as along a road), could authorities send a Sherriff and ambulance without activating Civil Air Patrol?

3. Initiating discussions with telematics providers (OnStar) to determine the feasibility of using a PLB device as a "backup" distress signal in the event that an OnStar equipped vehicle cannot send a distress signal via cellular wireless.

4. Reaching out to the vendors who manufacture and sell the products to encourage them to market the devices as 'Mayday' devices for travelers, as well as the current market sectors.

Longevity

This appears to be a very successful joint public – private relationship that will continue indefinitely.

4.2 Vehicle Based Communications

Vehicle based communications systems are the second major research area of this technology survey. Compared to personal communications devices, the product field is significantly more limited in its scope.

Summary

Vehicle based communications include any Mayday technology that is installed in a vehicle. The most obvious example is GM OnStar, currently installed in millions of vehicles. ATX Technologies is a distant second place in the market, supplying telematics services for BMW, Mercedes-Benz, and Rolls-Royce. Volvo supports their On Call system throughout much of Europe. Toyota and subsidiaries offer an advanced telematics product called G-Book, but as of 2007 the technology has only been implemented in the Japanese market. A U.K. based company with telematics experience in the European market has recently launched a U.S. based venture called I-Mob. While I-Mob was initially an after-market product, the company is currently in talks with Ford, who is testing the system for factory installation in its vehicles.

To date, all in-vehicle telematics services rely on the wireless cell phone network to communicate with the vehicle. While this ensures nearly 100% connectivity in major urban areas, coverage can be sparse in some rural areas. Likewise, mountain canyons can prevent service. In these cases, the on-board telematics systems are not able to transmit distress calls, or the vehicle's location. In 2008, older GM OnStar vehicles may begin losing service as analog cellular networks are dismantled.

Figure 5: In-vehicle Navigation System

The FCC has ruled that starting in 2008, carriers are no longer required to maintain their old analog networks. The process will likely occur over an extended period of time. Newer (post 2002) OnStar vehicles use digital technology (or have a digital upgrade option).

The current trend in the vehicle telematics industry is to focus on value-added consumer services such as turn-by-turn directions, music, real-time traffic, anti-theft and other features. There does not appear to be any current effort to extend the range of these services by incorporating satellite communications.

Another segment of the vehicle telematics industry is in-dash or after-market navigation systems. Example products in this category include TomTom, Garmin, Magellan, Clarion and Delphi among others. Initially limited to navigation on pre-installed maps, many of these devices now offer data links via a cell phone connection (connecting an external cell pone), or satellite radio downlink. Industry representatives indicated that their primary focus is consumer navigation, and that they don't see any near-future incorporation of emergency notification technology.

Outside the consumer market, advanced vehicle location systems do exist which use radio, cellular network and satellite hybrid communication systems to communicate the vehicles location (and allow voice communication). These systems are typically used by the military, emergency responders and industry to track and communicate with fleet vehicles. Although there does not appear to be a consumer market for these high-end systems, there is no reason the technology could not be adapted for this purpose. Innovation may bring costs down in the future, and make this a viable Mayday technology.

Ownership

Products are owned and operated by a range of public and private companies, including vehicle manufacturers. The products piggy-back on existing cellular wireless networks.

Market readiness

There is a steadily growing market for vehicle telematics. The growth of OnStar (now standard on all new GM vehicles) is proof that the product has reached maturity. Dashboard navigation and other features are becoming more mainstream.

Reliability

Vehicle telematics systems such as OnStar have proven extremely reliable. In-vehicle systems such as OnStar have gone through extensive engineering and testing, including years of use and subsequent redesign. The only limitations appear to be geographic coverage.

Geographic Coverage

All vehicle telematics systems to date use the extended (multi-carrier) cellular phone network as a communications medium. This dissolution of the analog cellular network may impact coverage in rural areas, though this is not entirely clear—presumably carriers will ensure digital coverage is available before removing analog service completely. Regardless, vehicle telematics suffers the same coverage limitations as a typical cell phone.

Potential Role for ENTERPRISE

In many respects, this technology is the “status quo”. However, given the large (and growing) market for in-vehicle systems, there is no reason that services could not be expanded or improved.

Further ENTERPRISE activities might include:

1. Conducting discussions with GM OnStar (or other telematics providers) on the feasibility of adding satellite communications to their technology package.
2. Investigating the more affordable option of including some form of satellite beacon technology. For example, the beacon could be initiated only when outside of cellular coverage, and when the vehicle has suffered a severe impact.
3. Initiating discussions with “industrial grade” vehicle location technology companies to investigate the potential for opening these products up to the consumer market.

Longevity

The vehicle telematics industry is well established and growing. Services become more robust at the same time that geographic coverage broadens. There is good reason to believe that the product offerings will continue to improve in quality and availability.

4.3 Road Infrastructure Communications

The final category of technology surveyed in this report is road infrastructure communications. Of the three areas considered, this is the most forward-looking. Whereas the other technologies considered have marketable products, road-infrastructure communications remain largely theoretical. Vehicle-to-roadside infrastructure communications are generally considered part of the Vehicle Infrastructure Integration or VII initiative.

4.3.1 Vehicle Infrastructure Integration (VII)

Summary

A great deal of promise surrounds VII, though much of it remains highly theoretical, or at least in the early prototype stage. The VII concept uses short-range communications to allow vehicles to talk to each other and the surrounding infrastructure. VII will use the IEEE 802.11p standard for “Wireless Access in the Vehicular Environment” to transmit data, at a range of up to 1000 meters.

VII, at its present stage, is perhaps most accurately described as an application framework. That is, it is a set of standards, policies, objectives and technologies that could be used to develop vehicle communications applications and “smart” road networks. The framework makes possible a nearly endless variety of transportation applications. However, at present, even the most basic applications are still in the early prototype phases. A 20 square mile test VII network is being established in

Detroit, scheduled for completion this year. It is clear that several key issues must be overcome before VII will become a widespread technology.

Perhaps one of the most critical issues facing VII is equipment deployment. This includes both On-board Units and Equipment (OBU/OBE) including vehicle sensors and communications devices as well as Roadside Units and Equipment (RSU/RSE). The expense and effort required will be considerable, and deployment will take place over an extended period of time.

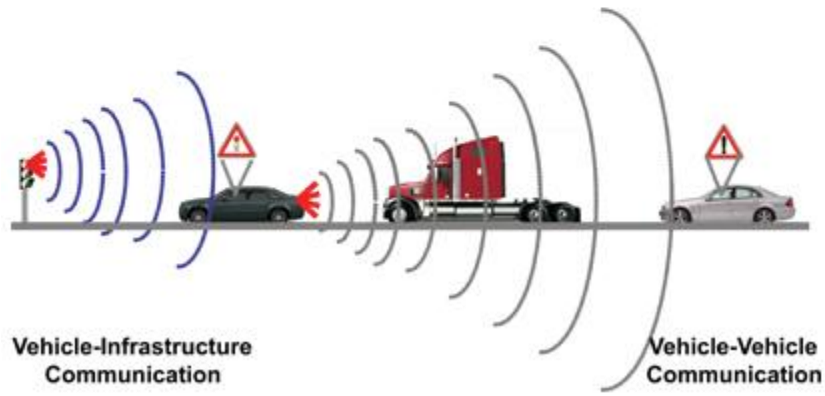

Figure 6: VII DSRC Concept

As pertains to emergency vehicle location, VII cannot be considered viable at the present, or even near term. While there may be some opportunities for research and planning, it will be a considerable amount of time before VII is deployed on a sufficient scale to make an impact at the national level. Also, VII is likely to see infrastructure deployment in urban areas first, where other emergency location services are already well developed, and will improve over time.

Ownership

VII involves a wide range of technologies, and will require road infrastructure installations, vehicle installations and supporting framework and communications. For these reasons, VII will not be "owned" by any one entity. As noted above, it is an "application framework" rather than a particular product. VII will be developed through a wide range of mechanisms including university research, public-private partnership, government funding, and consumer expenses.

Market readiness

The product is not ready for market.

Reliability

Reliability will be a critical factor in the development and success of VII. Important reliability concerns include stability, security and coverage.

Geographic Coverage

VII will initially have very limited coverage, and expand slowly over time. As with most new technologies, urban areas will likely benefit first and to a greater extent than rural areas. Although the VII vision calls for universal coverage on Interstates, and potentially all roads nation wide, that vision is a distant reality.

Potential Role for ENTERPRISE

Given the lack of near-future application for VII in terms of emergency vehicle location, efforts are probably best directed elsewhere. However, further research and development of VII-based emergency notification applications may be a beneficial project in the long term.

Phase 2: Industry Discussions and Work Group Meeting

Following the research and documentation in Phase 1, Phase 2 of the project was to solicit input from industry and government agencies, and hold discussions on where the project might go in the future. It was originally envisioned that many of the industry experts would travel to and attend a project workshop hosted by the Enterprise group. However, industry representatives were reluctant to speak on the record about many of the topics discussed in this report. They sited various reasons, but most specifically, they were a) reluctant to discuss the shortcomings of current products and systems and b) reluctant to discuss new technologies and products they were developing. The information that industry insiders were willing to contribute was presented to Enterprise members for discussion at the workshop, which occurred at the May 2007 Enterprise meeting in Virginia.

Industry, government and organization representatives contacted for this project include the following:

- Intrado
- Magellan
- Garmin
- 360 VL
- Networks in Motion
- NENA
- US DOT
- GM OnStar
- Skymeter
- Cellular Telephone Internet Association
- Rural Cellular Association
- 911 Dispatch center, Prince-Williams county, Virginia
- Metro Emergency Services Board, State of Minnesota.
- District 1a (Duluth), Minnesota State Patrol
- St. Vincent Hospital, Bend, Oregon (Rural Response, ER)
- American Ambulance Association
- The American Medical
- Clinton County Emergency Management, State of Iowa
- Loudoun County, Virginia, Department of Fire, Rescue & Emergency Management

Industry experts indicated the existing emergency notification systems generally overlap and work very well in urban centers and along corridors between urban areas. Here, communications media are well developed and most wireless providers are able to provide E911 Phase 2 location data. Rural areas typically have less developed communications infrastructure, lower implementation rate of Phase 2 E911 services. Thus most comments indicated an emergency notification gap in rural areas.

Many experts in the "location based services" industry indicated that they and their competitors are focused on the large markets in urban areas, and fewer products and technologies are being developed for the smaller markets found in rural areas. However, several key players companies indicated that there is a renewed interest in Satelliteatellite-based communications services, and that in the next few years the market will see significant innovation in this area. Industry representatives were particularly guarded about discussing specific products or technologies in this area.The E911 workshop which took place at the May ENTERPRISE meeting in Virginia discussed the initial technology survey, as well as the feedback from industry and government. Participants discussed the follow-up options for ENTERPRISE (see the Phase 1 technology survey). The group settled on three possible approaches for the project final report activities. One option suggested by Ray Murphy of FHWA was to concentrate on satellite communications, and investigate the possibility of setting up a field test, potentially as a future ENTERPRISE project. A second option, suggested by Karen Gilbertson of Kansas DOT, was to go back and attempt to further identify and (if possible) quantify the "notification gap" that exists in rural areas due to lack of technological options. Finally, Bill Legg of Washington State DOT proposed that the final report lay the groundwork for ENTERPRISE advocacy of rural issues as part of national efforts to establish a Next-Generation E911 system.

Because the project was designed as a "survey" effort with a small budget, the final report could not conduct activities in all of the suggested areas. Ultimately, the group elected to pursue further investigation of the extent to which rural motorists are unable to contact emergency response (and provide location information) in the event of a crash. Joop van Bergen made the case that it is important to establish a better understanding of the problem, and then use this information to argue for a market solution or pilot project. The agreed upon approach would be to conduct further discussions with rural agencies and organizations, particularly 911 dispatching centers, that would be able to provide anecdotal or statistical information on the extent of the problem.

Based on the conclusions of the working group, addition research was conducted into the extent of the "rural notification gap". Primarily the focus was on wireless coverage in rural and mountainous areas, and the experiences of 911 dispatchers in these areas. However, it was proven extremely difficult to establish a *quantitative* statement on the extent of the rural communication gap. Two distinct problems were discovered.

First, the organizations, agencies and companies who might have information on the extent of a communications gap (e.g., wireless companies, telematics providers) were understandably reluctant to provide any information on the shortcomings of their services. A good example of this are the "wireless coverage" maps provided by wireless carriers and telematics companies. These maps are widely understood as "ideal" coverage, and actual coverage may be somewhat less. Industry insiders and wireless associations are interested in promoting their industry rather than admitting certain areas do not have adequate coverage. This point was emphasized by contacts with NENA (The

National Emergency Number Association), who indicated that all wireless coverage maps assume ideal weather conditions, the best available handset, ideal terrain and do not factor in radio spectrum issues that might limit coverage or quality of coverage. Thus, even though a rural area may be "covered" on a provider's map, it does not mean that coverage is complete or reliable. NENA described this as a problem, but admitted there was no quantitative research on the extent of the problem.

The second problem with quantifying the emergency notification gap is that it is a "negative result" that is not easy to capture. That is, when an emergency request does eventually come in, the 911 systems and dispatchers have no way to identify whether someone (or some telematics system) had tried to reach 911 and failed—they only see the positive results. Thus most dispatch centers could provide only anecdotal information.

Many rural 911 dispatch centers did describe known problem-areas for wireless coverage that do affect emergency notification and response. Typically, on well-traveled highways this is not a significant or frequent problem because another traveler will observe a crash and then, if necessary, drive on to an area with adequate wireless coverage and make a 911 call. None of the dispatch centers that were contacted kept records of whether the 911 caller was able to reach 911 from the actual scene of the crash. Anecdotally, dispatchers felt that in really remote and hilly terrain there were occasionally crashes or other incidents that were not reported due to lack of coverage. However, unless the crash resulted in a fatality or severe injury, the communications gap was not generally remarked upon. Dispatchers did note that there are a few fatalities each year that might have been prevented with better coverage, or alternative means of reporting the crash. This conclusion is also confirmed by publicized accounts in the popular press. For example, the widely publicized death of motorist James Kim, whose family became stranded in a rural area of Oregon. Similar, less publicized tragedies are reported all over the country, and certain areas are known for vehicle tragedies that might have been prevented if communications means had been available (the Adirondacks area in New York are one such area).

The conclusion of this follow-up research is that statistically quantifying the extent of the rural emergency notification problem will require a sophisticated and targeted study. Anecdotally, there is a known problem, and there are motorists stranded or involved in crashes that cannot obtain an emergency response. However, the extent of the problem cannot be adequately established given the limited scope and budget of this project.

5. Conclusions and Next Steps

The premise of this project was to not assume that the challenge of locating stranded or injured motorists in need of urgent care has been completely solved by private sector communication media or telematics services providers (TSPs) such as OnStar. Thus this research project sought opportunities for those who do not have TSP services, or who otherwise could not communicate their need for urgent response to the proper authorities.

The Phase 1 technology summary investigated and summarized potential Mayday technologies that motorists might use to better alert Emergency Response services to their distress and location. These technologies were divided into personal communications devices, vehicle-based devices and road-infrastructure devices. Of the three, personal communications devices proved the most practical and affordable for the near future. Of particular interest are satellite phones and personal locator beacons. The costs of owning and operating a satellite phone are nearly comparable to traditional cell phones, while personal locator beacons are relatively inexpensive and dependable.

The technologies presented in Phase 1 were discussed and evaluated at the Phase 2 workshop, at the May 2007 ENTERPRISE meeting. Based on feedback and direction received at the workshop, additional research and follow-up activity focused on an attempt to quantify the existing gap in emergency communications in rural areas, which are underserved by current technology. This research confirmed that many rural emergency responders know a problem exists, but no quantitative study of the problem has been undertaken. Anecdotal evidence suggests that motorists can become stranded in rural areas and have no means of requesting emergency aid.

Several conclusions can be drawn from the research conducted under this project. The first of these conclusions is that a more rigorous field study of rural crashes and emergency response may be warranted. A formal study could be used to justify additional or improved technological solutions for emergency notification in the event of a crash. A second major conclusion is that there exist several practical technological solutions that are presently not widely used for crash notification (in particular, satellite phones and personal locator beacons). Thus, if a quantified demand for these devices can be established, a case can be made for their deployment.

This report suggests a number of follow-on activities for ENTERPRISE regarding individual emergency notification devices. However, at a more general level, at least two activities seem likely to impact the problem this report identifies. First, ENTERPRISE could use this report and a future project to join the Next-Generation E911 development effort, and advocate for solutions which particularly address the needs of rural motorists. For example, ENTERPRISE might work with NOAA to establish PLB devices for use by motorists, and then argue that the PLB notification be integrated with the Next-Gen E911 system. The costs of such an effort would be modest, and might have a significant impact on the safety of rural motorists.

A second follow up activity to this project would involve working with satellite phone makers and a telematics provider (e.g., OnStar) to pilot test the use of satellite phone technology in a crash notification system. This approach appears technologically feasible. A simplified (and less expensive) satellite communications device could be fitted to the existing in-vehicle crash notification system, and used when traditional wireless communications are unavailable. The feasibility study could be used to test the technology, and establish whether it is a commercially viable addition to existing telematics services.